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The N. E. L. A. Convention in Chicago

For the seventh time the National Electric Light Association — which might be more comprehensively termed the National Electric Association—is preparing to hold its convention in Chicago. This will be the thirty-sixth convention of the association, although the organization is only twenty-eight years old, semi-annual conventions having been held before 1892. As has been the case for several years, elaborate preparations have been made for the great gathering which is expected. The officers and the various committees of the association do a large amount of hard work in preparing for these meetings, the staff at headquarters, the local convention committee, the hotel committee and the transportation committee being particularly active in the two months preceding the convention. Nowadays all the committees are working committees, and many of them hold numerous meetings and give a great deal of attention to the work of the organization, the activities of which are now exercised all the year round. This year's convention program gives promise of the contribution of much information of value to those engaged in the electric-service industry. General, technical, hydroelectric and transmission, commercial and accounting sections are provided in seventeen sessions, beginning Tuesday morning, June 3, and ending Friday afternoon, June 6. On several occasions there will be simultaneous sessions. As in recent years, much of the material presented will be in the form of reports from committees, but there will also be a number of contributed papers. Class D members will exhibit electrical apparatus during the convention. The city selected for the convention is extremely interesting from the viewpoint of the electric-service operator. It is easy of access and has ample hotel accommodations. Entertainment on an elaborate scale has been provided for the visitors, especially the ladies. One novelty to which attention may be here called is the fact that some of the sessions of the technical and commercial sections will be held in a large tent on a lawn in the rear of Medinah Temple. With the attractions of convention week, it is sure that the attendance will be very large, although it would be idle to attempt to speculate in advance on the exact number.

The Customer's Viewpoint

One of the most amazing things about human nature is the preconception with which the average purveyor of a service goes busily about rendering that service either as he thinks it should be done or as fits his convenience, without ever stopping to consider just what it is, after all, that the recipient of the service really wants or ought to have. This failure to get the customer's viewpoint is a shortcoming that is perhaps more seriously chargeable to corporations that deal with large groups of the public than to any other class. In how many railroad stations of this country, for example, is there exposed for view a wall timetable showing train movements? And yet to every person who enters the station this would furnish the most useful information possible, saving needless inquiries at the ticket window, the time of the agent and a large portion of the folders now thrown away after a moment's consultation. In how many hotels of this country has the management thoughtfully framed and hung up a street map of the local community, showing car lines, principal buildings and industries? Yet every stranger would consult and appreciate such a map to guide him to his local destination, saving the usual indefinite and inaccurate verbal directions. It is gravely suspected that the business offices of some utility companies are arranged and run in ways that afford more convenience and peace of mind to the staff behind the counters and windows than to the unsophisticated customer who comes in to transact some simple business with the great corporation. It would be an illuminating experience for some central-station managers if they could assume an incognito and go through once, for themselves, the intricacies and embarrassments of making application for service, paying a bill or registering a complaint in their own offices!

Chicago Central-Station Development

The extent to which the idea of unified electric supply has been carried in Chicago and adjacent territory is well shown in articles appearing in this issue. Following the purchase of the Chicago Arc Light & Power Company and the absorption by the Commonwealth Electric Company of many small electric-service companies operating in the outlying portions of the city, came the consolidation of the two companies into the present Commonwealth Edison Company, the dominating force in the electric-service business in Chicago. About one-fourth the receipts of this company represent energy sold to other public-service companies, notably electric-railway companies, at inviting low rates. The cost of producing energy has been reduced not only by eliminating unnecessary duplication of operating force but by increasing the size of the generating units. In 1888 the generating units were rated at 160 kw each; in 1902 3500-kw units were in service; in 1912 20,000-kw units were installed, and an order has been placed for a 30,000-kw unit. An important year in the history of Chicago central-station development was 1897, when the first synchronous converter was installed, thus marking the beginning of the production of electrical energy where it could be manufactured cheaply in large quantities and transmitted to relatively distant points at which it could receive whatever pressure or form was desired for domes-

tic or industrial service. Full advantage is always taken of the diversity-factor between the loads in the different industries and domestic services, the benefits being participated in by the consumers as well as the company. Thus has been developed an electrical energy supply system which exceeds every other single system in the amount of energy sold and the number of customers served. Its success, which has been founded on an enlightened application of the economic principle of monopoly in energy supply, proves that the economical benefit to the community served can best be shared with the public-utility company making such benefit possible, thereby encouraging the company to extend the application of the economic principles to the increased benefit of the community as a whole.

The Mississippi Power Plant

To evaluate justly the characteristics of the huge hydroelectric system at Keokuk one must turn aside from ordinary precedents and consider the elements of design that are necessarily affected by mere increase of size. Commonly these are overestimated, and to meet imaginary conditions many a plant has been overburdened with complications that were both costly and needless. When, however, one deals with the necessary concentration of 300,000 hp in a single development under unusual hydraulic conditions and requiring a power house more than a quarter of a mile long, unusual methods may be logically required. To begin with, the Keokuk development is by far the mightiest low-head proposition ever undertaken. The Mississippi is not a precipitous stream, and it was sheer good fortune, the result of a geological freak, that enabled even so modest a head as 32 ft. to be utilized without absolutely prohibitive expense. The first striking feature of the plant, the single-runner colossal vertical-shaft turbine, is the direct consequence of the low head. Generally one tries to get a fairly high generator speed by using multiple runners. In this case the large output required very large units to avoid outrageous complications, and the enormous volume of water to be dealt with for each unit forbade the complication of multiple runners on so low a head. Hence the considerable variations of head from 20 ft. to 39 ft. had to be managed by finesse in turbine design without aid from the devices available with smaller units. So gigantic are the turbines that the scroll chamber delivering the water to the runners is nearly 40 ft. in diameter and is simply molded in concrete. Similar considerations apply to the generator design. With an output of 7200 kw at 57.7 r.p.m. the dimensions of the machines become imposing, each being more than 31 ft. in diameter.

The great output at low speed was very probably one of the chief factors in the choice of the low frequency of 25 cycles, which ordinarily is open to the objection of being too low for incandescent lamps and rather high for the supply of energy to alternating-current commutator railway motors. The necessity of supplying all energy through frequency changers or synchronous converters is a handicap on final industrial efficiency of which the wisdom remains to be proved. Certainly no plant except one of vast output, certain to sell its product at wholesale only and over very long distances, could afford to take the chance. There are other points of interest about the generators. The mere fact that from the dimensions of the power house it has proved advisable to use alternating-current distribution of exciting energy to individual motor-driven exciters is in itself striking, but the complete control of the generators by the exciter field is of more real interest as tending toward simplification, and especially there should be noted the method of field regulation in which the automatic regulator responds to dangerous overload conditions by putting reactance in the generator excitation circuit so as greatly to depress the voltage without finally putting the machine out of action. The generators are in themselves designed for rather large reactance so that even without the precaution just noted the current on dead short-circuit is limited to five times the normal full load. Moreover, the possibilities of a short-circuit are guarded against by the use of a working bus sectionalized through reactors, each section carrying only four units and being provided with automatic means for isolating itself in case of too severe overloads.

One thing usually to be commended is the rather general use of non-automatic switches in the general working of the system. Recent experience has led to a certain distrust of relying too much on automatic devices to the exclusion of human intelligence, which itself seems all too inadequate to meet the exigencies of service. In the Keokuk plant the effort has been made to provide the system with such automatic safeguards as will retard the approach of dangerous conditions and give time for the operators to take care of the crisis without a shut-down. Along the same line of trusting intelligent operation to pull the system through is the installation of emergency switches in the generator room, a precaution too often neglected. Many things can happen while one is attempting to signal to a possibly flustered switchboard operator unable to see the conditions existing. Another interesting safeguard is the operation in parallel of all the generator regulators with series transformers in the main leads so that there is automatic regulation of exchange currents as between one unit and another.

The main transmission line from the Keokuk plant is operated at 110,000 volts to deliver energy to St. Louis, 144 miles distant. This line presents no extraordinary features except those of magnitude. There are two circuits of 300,000-circ. mil cable carried on steel towers set at a normal span of 800 ft., and provided with a steel ground cable, as is now common. The factor of safety in the insulators is noteworthy, however, being four when dry and three when wet, which is considerably higher than on the ordinary high-tension line. In fact, the insulation throughout the system is intended to have at least three as a factor of safety in spite of the extreme voltages. For the care of the line a special telephone line is erected at the edge of the right-of-way on its own poles, with telephone booths every 4 miles. The general supply of energy is just beginning to get under way, and the possibilities of the situation have as yet barely been touched. All told, the Keokuk enterprise is a huge one, with great output, high cost and immense possibilities of industrial usefulness over a large and prosperous territory.

A Great Rural Network

The widely ramifying system now under construction by the Central Illinois Public Service Company and described in our columns this week is perhaps the most conspicuous example of what may fairly be called a rural distribution which has yet appeared. In calling it rural we do not mean to imply that there are not considerable towns and important industries included in the territory. It is merely that the fundamental plan of the network, which ultimately will sweep a radius of nearly 350 miles, is to gather into one management and one physical system the electrical requirements of a very large and not heavily populated territory. The magnitude of the scheme and the character of the distribution may be best realized by noting that, with a total population of a quarter of a million, 125 communities are to be served and 90 local generating plants will be replaced by a small group of modern central stations. The general plan of management is that obviously appropriate to the system, of having a central directing management charged with the general administration of the system but leaving each particular supply district in the charge of a district superintendent who is held responsible for all of the local work.

Physically the properties are of very diverse kinds, including direct-current plants and two-phase and three-phase plants at frequencies of 133, 60 and 25 cycles. This heterogeneous service is now in process of standardization to three-phase, 60-cycle distribution with transmission at 33,000 volts and distribution at 2300. The complete unification of the amalgamated system will require some 700 miles of transmission system, of which about 150 are now built. The line work is as nearly as may be uniform and of a very simple character. It consists chiefly of single circuit lines, on poles of moderate height, carried on porcelain insulators supported by steel pins on wooden cross-arms. Each circuit has a complete ground-wire system, is regularly transposed and is provided with exceptionally solid construction at every railroad crossing. Heavy stranded copper conductor is used at these crossings to reduce to a minimum the chance of breakage. An interesting feature of the line work is that while the circuits follow country roads or the railways, whenever possible the poles are actually set 2.5 ft. back in the adjacent land so that the pole line and conductors are in large measure on a private right-of-way adjacent to the public way. This arrangement has the double advantage of keeping clear of the frequent objections to having high-tension lines on public roads without sacrificing the accessibility and ease of inspection that such roads give. In some cases the public roads or the railroad rights-of-way have to be utilized, but the practice just noted is intended to be the standard one.

At all important centers there are substations doing the ordinary work of distribution, while where the local demand is smaller outdoor substations of rather interesting character are utilized. These substations consist of square skeleton steel towers carrying midway of their height, about 12 ft. from the ground, platforms, 13 ft. by 6 ft., suited to carry a group of three transformers of ratings up to 50 kw each. The tower carries the horn lightning arresters, and the ingoing lines to the transformers are fused. The base of the tower is of concrete, forming the floor of a little switchroom containing the necessary oil switches for the local distribution and affording room if necessary even for a small series transformer for street lighting. These rudimentary substations are one of the particularly noticeable features from an engineering standpoint, and about thirty of them are in use. So much for the general and physical nature of the network.

As regards its load characteristics, there are numerous points worth considering. The territory covered included some 200 coal mines, at the mouth of one of which the present chief generating station is located. It is expected that a large and constantly increasing amount of energy will be utilized for the operation of these mines, which are sufficiently numerous to give on the whole a fairly steady load. Moreover, the miner's day ends at 4 o'clock, and consequently the mining load will greatly help the diversity-factor of the system, since it will be almost wholly off by the time the lighting peak comes on. Another striking feature of the load is the pumping work which can be successfully undertaken. Part of this is the ordinary steady-load pumping of small town water-works, extremely helpful to the diversity-factor inasmuch as the standpipe storage can keep the load off the peak. A second class of pumping work is that in connection with the drainage pumping in the valleys of the Illinois and Mississippi Rivers. In the territory reached there is not less than 200,000 acres of rich farming land just enough below the high-water level to require drainage by pumping at certain seasons of the year. A large part of this area is now drained by steam pumping plants of a somewhat expensive and inconvenient character, although a beginning has already been made in electric pumping. The total amount of water to be disposed of during the year is equivalent to about 10 in. of rainfall, but the lift is only some 10 ft. or 12 ft. Most of the pumping load is concentrated into three months in the spring. Here again the load is excellent in its relation to the diversity-factor because not only does the general lighting load fall off by the time of year when the main pumping load comes on, but the mines are through this same season usually working at reduced output, so that ample generating equipment for supplying energy for pumping is released. The electric pumping has shown itself here and elsewhere to be economically advantageous, so that the chance of obtaining in this way a market for energy from the system is excellent.

In some of the towns now supplied with energy from this system there is a certain amount of central-station heating from exhaust steam or otherwise which has been taken on in the past. It is proposed to make use of this fact in the general plan of energy supply under the new system. During the winter the existing stations doing steam heating can aid the system and be shut down as soon as the heating demand ends. Correlative to this, there are in operation nearly a dozen artificial ice plants, of which the chief activity lies in the summer and which serve again to equalize the load. The whole system is a very striking example of modern tendencies toward consolidation of physical unification of small properties, and its further development is worth watching with close attention.

The News of the Week

Activities and Events in the Electrical Field—Reports of Meetings—Commission Findings, Etc.

The N. E. L. A. Convention

For the thirty-sixth convention of the National Electric Light Association, which will be held in Medinah Temple, corner of Cass and Ohio Streets, Chicago, on June 2 to 6 inclusive, elaborate preparations have been made as a very large attendance is anticipated. The advance out-of-town and local registration on May 24 had reached about 2500 names. Secretary T. C. Martin and his staff and Mr. H. G. McConnaughy, secretary of the exhibition committee, have been in Chicago all this week, while a large number of Chicago electrical men, including Messrs. George B. Foster and Ernest A. Edkins, secretaries of the general convention and entertainment committees, have been at work on the preparations for several weeks. The condensed program of events for convention week is as follows:

Monday morning, June 2, opening of registration office at Medinah Temple at 10 o'clock.

Monday evening, opening of exhibition of Class D members, 8 o'clock; reception in the main auditorium of Medinah Temple, 9 o'clock, followed by dancing.

Tuesday morning, 10 o'clock, first general session.

Tuesday afternoon, 2:30 o'clock, first technical session, first commercial session, first accounting session.

Tuesday afternoon, 3 o'clock, musicale in the ballroom of the Blackstone Hotel, Michigan Avenue and Hubbard Place, for visiting ladies only.

Tuesday evening, 8 o'clock, circus and vaudeville in the main auditorium of Medinah Temple under the auspices of the Commonwealth Edison Company Section of the N. E. L. A. and the Electric Club of Chicago.

Wednesday morning, 10 o'clock, first hydroelectric and transmission session, second commercial session, second accounting session; 11:45 o'clock, second general session.

Wednesday afternoon, excursions to the Northwest generating station of the Commonwealth Edison Company and the Hawthorne works of the Western Electric Company; other industrial excursions available by selection. Invitations have been received to visit the Chicago Drainage Canal, the steel works at Gary, Ind., the Union Stockyards and the tunnels of the Chicago Tunnel Company. The annual baseball game, to be played at the grounds at Northwest station on Wednesday afternoon, will be between teams representing the New York Edison Company and the Commonwealth Edison Company of Chicago. Both of the nines are composed of excellent amateur ball players employed by the companies named, and an exciting and closely contested game is anticipated. The New York Edison Company will send to Chicago for this occasion nineteen men, who will travel in a special car, all of their expenses being defrayed by the company. Visiting ladies who do not wish to attend the ball game or the industrial excursions will receive tickets to an afternoon performance of the missionary pageant at the Auditorium entitled "Darkness and Light," also to the missionary exposition at the Coliseum known as "The World in Chicago."

Wednesday evening, 8:30 o'clock, public-policy session, with addresses by Messrs. Samuel Insull, W. C. L. Eglin and J. B. Douglas.

Thursday morning, 10 o'clock, second technical session, third commercial session, third and last accounting session.

Thursday morning, 10 o'clock, automobile trip for visiting ladies. Leaving the Art Institute, Michigan Avenue and Adams Street, the party will proceed through the North Shore suburbs to Highland Park, where luncheon will be served at the Moraine Hotel. The return will be made in the same manner in the afternoon.

Thursday afternoon, 2:30 o'clock, second hydroelectric and transmission session, fourth and last commercial session.

Thursday evening, rejuvenation and joviation of the Jovian Order at White City Park, East Sixty-third Street and South Park Avenue.

Friday morning, 10 o'clock, fourth and last general session, third and last hydroelectric and transmission session.

Friday afternoon, 2:30 o'clock, third and last technical session, followed by election of officers and adjournment.

Some of the technical and commercial sessions will be held in a large tent on the lawn in the rear of Medinah Temple.

A feature of the convention not included in the earlier program is a paper on the electric-vehicle situation to be presented by Mr. E. E. Witherby, of the General Vehicle Company, Chicago, before the Commercial Section, on the electric vehicle as affording an excellent central-station opportunity.

N. E. L. A. Preparations for the Ladies

Perhaps the most elaborate feature of the entertainment for the visiting ladies to the N. E. L. A. convention at Chicago will be an automobile ride to Highland Park and return and a luncheon at the Moraine Hotel on Thursday, June 5. Public-spirited electrical men will lend their automobiles and chauffeurs for this occasion, and a number of cars have been tendered to the committee. Mr. Godfrey H. Atkin, chairman of the transportation sub-committee of the Chicago committee, is making the arrangements with the owners for the use of the automobiles. The cars are to assemble in Grant Park just east of the Van Buren Street Viaduct at 10 o'clock on June 5 and will be placed under the direction of the transportation committee. It is expected that they will reach Chicago on the return trip about 5 o'clock that evening.

Tentative Program of the Edison Association

The program for the twenty-ninth annual convention of the Association of Edison Illuminating Companies, which will be held this year at the Hotel Otesaga, Cooperstown, N. Y., during the week beginning Sept. 8, has been tentatively arranged. In addition to the regular reports of standing committees, papers on the following subjects will be read: "Murray Process of Collecting Cinders," "Boilers of Extra Large Steaming Capacity," "Model Public Utility Bill," "Depreciation," "Safety Devices in Central Stations," "Safety to Employees," "Welfare Work," "Electric Signs," "Electric Appliances Salesroom," "One Year's Activity by the Boston Edison Company in Promoting the Use of Energy-Consuming Devices and the Results," "Flaming-Arc Lamps," "Exchange of Advertising Material," "Corporation Schools," "Large Power-Station Design," "Hydroelectric Developments in Canada," "Rate Changes and

Their Effect on Earnings," and "Electric Vehicles." There will also be two papers prepared by representatives of the large electrical manufacturing companies, one from the General Electric Company and the other from the Westinghouse Electric & Manufacturing Company.

Ithaca Meeting of Empire State Association

The third midyear meeting of the Empire State Gas and Electric Association was held in the rooms of the Business Men's Association in Ithaca on May 23 and 24. Papers were presented by Mr. C. A. Graves, of the Southern New York Power Company of Walton, N. Y., on "Special Problems of the Small Electric Company," and by Mr. V. A. Miller, of the Canandaigua (N. Y.) Gas Light Company, on "Problems of the Small Gas Company." An interesting discussion followed the presentation of these papers. An automobile trip around the city and the campus of Cornell University was given to the delegates after the meeting on May 23, through the courtesy of the Ithaca Automobile Club. They went to the Rogue's Harbor Country Club for dinner, following which another short business session was held. Most of the delegates spent the night at the Country Club, returning to Ithaca on the morning of May 24, taking in the Spring Day exercises at Cornell University and the baseball game and boat race in the afternoon. The arrangements which had been made by the Ithaca companies for the entertainment of the delegates provided a most enjoyable outing as well as an instructive meeting. Mr. C. H. B. Chapin, Engineering Societies Building, New York, is the secretary of the association.

Resale Price-Fixing on Patented Articles Unlawful

The Supreme Court of the United States handed down a decision on May 26 in the case of the Bauer Chemical Company versus James O'Donnell relative to the sale of a nerve tonic for which a patent had been issued, holding that owners of patents do not have the right by patent law to control the price at which retailers must sell to consumers. The court stood five to four, and although the manufacturers relied chiefly on the celebrated "mimeograph case" decided about a year ago, Justice Day, who announced the decision, said that an examination of the latter case showed that that restriction was sustained because the machine was sold at cost or less, and that the owner depended on the profit realized from the sale of unpatented supplies to be used upon the machine for reward for his invention. The restriction in that case also had to do with the use of the machine and only a "qualified title" to the patented article passed, whereas in the present case the restriction was "to keep up the price," the sale to the retailer having been absolute. It was held that while the patent law gave the owner the exclusive right to "vend" articles, that was not the same as a right to "keep up the price." That, the court held, was not granted by patent law.

Publicity Campaign of Electric Vehicle Association

Active solicitation for contributions to the 1913-1914 co-operative publicity campaign fund of the Electric Vehicle Association of America has thus far resulted in the collection of over $26,000. The committee, of which Mr. Frank W. Smith, of the United Electric Light & Power Company, New York, is chairman, is striving to obtain at least $50,000 in order to continue the work of last year. It has been generally conceded that the active work of the association, particularly along the lines of co-operative educational publicity, has been no small factor in the great increase in the output of electric vehicles and accessories during the past twelve months, and if the benefits are to be cumulative the work of the publicity and advertising committee ought to be carried on with greater vigor. Last year the campaign was largely educational in character, and this year the intention is to make a more direct and specific appeal to the purchaser, giving data with respect to the operation of both commercial and pleasure cars. In addition, the committee will issue two booklets, one entitled "The Story of the Electric Commercial Vehicle" and the other "The Story of the Pleasure Vehicle." Both will be got up in attractive form for general distribution.

Meeting of International Electrotechnical Commission

The International Electrotechnical Commission will meet at Berlin, Germany, Sept. 2 to 6 inclusive. The program of the meeting has not yet been announced, but reports from the committees on nomenclature, symbols, rating and prime movers will doubtless be presented. It is expected that several delegates from the United States National Committee of the American Institute of Electrical Engineers will represent America. The next meeting after that at Berlin is scheduled for 1915 and will take place in conjunction with the San Francisco congress to be held at the time of the Panama Exposition.

National Electrical Supply Jobbers Convene

The spring meeting of the National Electrical Supply Jobbers' Association was held in the Congress Hotel, Chicago, May 26, 27 and 28. Unlike previous conventions, when certain portions of the day were devoted to entertainment features, the meeting this week had a purely business aspect. During the first two days executive sessions were held, the general subject for discussion being economical methods of conducting business. Mr. F. Overbaugh, of Chicago, secretary of the association, presided at the sessions and several well-known men in the electrical industry made addresses. One of the speakers at the meeting on May 28 was Mr. J. M. Wakeman, general manager of the Society for Electrical Development, who dwelt at length on the scope, aims and purposes of the society.

A. I. E. E. Affairs

A meeting of the American Institute of Electrical Engineers will be held in Philadelphia on Oct. 13, 1913, under the auspices of the Philadelphia Section. Authority for holding this meeting was given by the board of directors at its May meeting.

Upon recommendation of the board of examiners 99 students were ordered enrolled, and 149 associates and five members were elected. Mr. Francis D. Egan, Pittsburgh, Pa., and Mr. George T. Street, Puerta Plata, Santo Domingo, were transferred to the grade of member, and Dr. Louis Duncan was transferred to the grade of fellow. Prof. A. F. Ganz was appointed a member of the board of examiners to fill a vacancy.

The special committee appointed by the board last January to examine applications for transfer to the grades of member and fellow filed under the special section of the constitution reported a list of 56 applicants for transfer to the grade of fellow and 142 applicants for transfer to the grade of member whose applications the committee had examined and found to comply with the requirements of the special section. These 198 applicants were thereupon transferred.

The board approved an amendment to the Edison Medal committee's by-laws, the amendment providing that the medal shall be presented at such time and place as may be arranged by the officers of the Institute, provided that the presentation shall be made during the administrative year

in which the award is made. The by-laws formerly provided that the medal should be presented at the Institute's annual meeting in May. In accordance with this amendment, arrangements are being made to present the 1912 medal to Mr. William Stanley at the annual convention at Cooperstown, N. Y., June 23-27.

Mr. F. L. Hutchinson was unanimously reappointed secretary of the Institute for the administrative year beginning Aug. 1, 1913, in accordance with the constitutional provision that the secretary shall be appointed at the board of directors' first meeting of each fiscal year.

Chicago Electric Club and Jovian Co-operation

The Electric Club of Chicago and the Chicago Chapter of the Jovian Order held a joint luncheon on May 22. About 144 men were present, 90 of whom are members of the Electric Club. The luncheon, which was planned by the Electric Club, was looked upon as quite eventful, in that it is the first time that the two societies have combined on such an occasion. Mr. Homer E. Niesz, chairman of the entertainment committee of the club, reported that the Commonwealth Edison Company and the Electric Club would join in reproducing the circus which was given on May 10 by the Commonwealth Edison Section of the N. E. L. A. This circus will be given at Medinah Temple on the evening of June 3 during the N. E. L. A. convention. Mr. Charles F. Hatfield, field secretary of the Panama-Pacific International Exposition of 1915, spoke briefly of the electrical features of that exposition. Mr. S. W. Harvey announced that the Jovian Order had received the application for membership of Mr. George C. Keech, president of the Electric Club, which was reciprocated by an application for membership in the Electric Club from Mr. A. R. Dean, statesman at large of the Jovian Order, Chicago Chapter. Mr. Eugene A. Rummler, patent attorney in Chicago, introduced Judge Cutting of the Probate Court of Chicago, who was the principal speaker of the occasion. Judge Cutting, in discussing "Judicial Efficiency," defended the judiciary, which is receiving harsh criticism from numerous sources at present. Mr. Frederic P. Vose expressed the club's appreciation of Judge Cutting's talk. Dr. M. G. Lloyd submitted a resolution declaring that the Electric Club of Chicago, desirous of increasing the efficiency of the judiciary, favors the elimination of all political party designations from ballots for the election of judges, and ordering "that a copy of this resolution be transmitted to each member of the Legislature from Cook County and to the Governor of Illinois." The resolution was adopted by a unanimous vote.

Relief of Transportation Congestion in Chicago

As chairman of the executive committee of the Chicago Elevated Railways Association, Mr. Samuel Insull on May 19 submitted two plans before the City Council committee on local transportation for relieving the congestion in the loop district. One plan provided for the lengthening of all existing elevated-railway platforms within the loop so as to accommodate two six-car trains at a time. This proposition would require a total extension of platforms amounting to 6000 ft. in the loop district and would permit of 1220 cars being handled per hour in the same district. Eleven hundred cars could be circulated per hour if the loop schedules were properly adjusted and the existing platforms extended to accommodate only one six-car train.

A through north and south route was also provided for in the plans over the South Side and Northwestern Elevated Railroads' tracks with suitable transfers to the Chicago and Oak Park and Metropolitan lines. Transfers between the two last-named lines were arranged at the point where the roads cross each other west of the city.

The elevated railroads in Chicago at the request of the committee on local transportation submitted a draft of an ordinance requiring increased transportation facilities. The draft was referred to the corporation counsel of Chicago for examination.

Mr. James F. Bowers, president of the Loop Protection Association, protested against the plans, saying that the extensions to platforms are unnecessary. In a communication from the elevated railway companies, which were represented by Mr. W. G. Beale, attorney, they said that in the event the city did not approve of Mr. Insull's plans they would be willing to lease subways built by the city in case they were constructed in localities which were favorable to the operation of their trains.

The plans submitted were referred to the Board of Supervising Engineers and the Board of Public Works, which are to report at a subsequent meeting of the committee as to their feasibility and effectiveness.

Electrolysis Problems in Chicago

Mr. Ray Palmer, city electrician of Chicago, submitted a report to the corporation counsel of that city on May 20 alleging that neither the surface nor the elevated traction companies are complying with the electrolysis ordinance effective April 15, 1913. A general inspection of several of the companies' generating stations and substations showed, according to Mr. Palmer, that no attempt had been made to equip uninsulated return feeders with pilot wires and instruments whereby the potential drop over different sections could be measured. Failure on the part of the companies to comply with this regulation of the ordinance has handicapped the Department of Electricity of the city of Chicago, it is declared, in checking the differences of potential between the negative busbars in the stations and sections of the return circuits.

Tests were made during the months of April and May at various generating stations and substations for elevated railways to ascertain whether the maximum limit of 12 volts drop between any two points of the return system is maintained. Mr. Palmer reports that under the most favorable operating conditions for the companies the maximum limit is being exceeded. The conditions existing on the surface railways are being inspected at the present time. It will be several more weeks before the preliminary experiments are completed, on account of the delay occasioned by the absence of the recording instruments required by the ordinance.

Mr. Palmer adds that the companies have made numerous improvements in the electric return circuits since the passage of the ordinance and says that more improvements are planned for this year, but he reports that none of the companies is complying with the ordinance at the present time. Potential drops between the negative busbars and certain sections of the return feeder were found to be as high as 35 and 54.5 volts in two cases during the rush hours. The maximum hourly average in one case was estimated as being 21.8 volts. The companies have intimated that the matter will be settled in the courts, as the requirements of the ordinance, in their estimation, are unreasonable.

It is provided in the ordinance that all uninsulated electrical return circuits must be of such current-carrying capacity and so arranged that the difference of potential between any two points on the return shall not exceed the maximum of 12 volts. Between any two points on the return 1000 ft. apart within a mile of the City Hall the difference of potential shall not exceed 1 volt. Between any two points on the return 700 ft. apart outside of this mile boundary, the difference of potential shall not exceed the limit of 1 volt. In addition, a proper return conductor system must be so installed and maintained as to protect all metallic work from electrolysis damage.

Heavy Sleet at Glace Bay

Recent issues have contained references to record-breaking sleet deposits in northwestern New York and in and about Chicago, and in the April 27 number an accumulation of 2 in. of sleet upon the telephone wire of the Montreal & Southern Counties Railway was noted. Through the courtesy of Mr. J. H. Winfield, general manager of the Maritime Telegraph & Telephone Company, Ltd., of Halifax, N. S., we are enabled to show herewith photographs of sleet as thick as 6 in. found on the telephone wires of the company at Glace Bay. Four severe sleet storms visited that locality within a period of three months, the last one of which left sleet in some places as thick as 8 in. On Feb. 19 a northeast wind and a heavy mist conspired to cover the lines with an enormous ice load. Not only were the telegraph and telephone circuits interfered with, but the lighting and railway lines were broken in a great many places and where they were not down they were grounded. All electric public utility service was completely demoralized for days.

FIG. 1—HEAVY SLEET ON TELEPHONE WIRE

FIG. 2—ONE-HALF FOOT OF SLEET ON TELEPHONE WIRE

Fig. 1 is a view taken three days after the storm of Feb. 20 and shows sleet on telephone wires on Chapel Hill, Glace Bay, Cape Breton, and Fig. 2 shows a portion of another wire in the same locality on which there was a 10-in. covering of snow and sleet, the ice itself being 6 in. thick and the wet snow covering making up the remainder. Another 6-in. coating of ice is shown in Fig. 3, taken on Dec. 2, three days after a storm at Glace Bay. All three illustrations show unusual conditions of sleet and give some idea of the loads carried by overhead lines in Cape Breton.

FIG. 3—TELEPHONE WIRE WITH 10 IN. OF SNOW AND SLEET

Convention of Railway Telegraph Superintendents

Mr. J. B. Sheldon, president of the Association of Railway Telegraph Superintendents, presided at the thirty-second annual convention of the association held at the Planters' Hotel in St. Louis on May 20, 21, 22 and 23. Eight papers were delivered in the following order: "Some Facts Concerning Telephone Transmission," by Messrs. E. Miller and C. A. Robinson, of New York; "Use of the Telephone by Railroads for Dispatching Trains, Handling Messages, etc.," by Mr. J. C. Johnson, of Philadelphia; "Inductive Disturbances as Affecting Telegraph and Telephone Circuits," by Mr. P. J. Howe, of New York; "Protection Against Lightning and High Currents for Telegraph and Telephone Equipment," by Mr. M. H. Clapp, of St. Paul; "Main-Line Power for Selective Circuits, Including Transmission and Signaling," by Mr. Richard F. Spamer, of New York; "Full Use of Wires," by Mr. H. D. Teed, of Springfield, Mo.; "Organization for Maintenance of Lines," by Mr. M. C. Allen, of New York; "Organization for Wire Chiefs and Telephone Inspectors," by Mr. J. B. Sheldon, of Omaha.

An executive meeting was held on Thursday. Mr. William Bennett, of the Chicago & Northwestern Railway, was elected president. Messrs. A. B. Taylor, of the New York Central & Hudson River Railroad, and P. W. Drew, of the Milwaukee, St. Paul and Sault Ste. Marie Railway, were elected vice-president and secretary-treasurer respectively.

Several informal dinners, vaudeville entertainments, a ferry-boat ride on the Mississippi and automobile rides around St. Louis constituted the entertainment during the convention. New Orleans was selected as the meeting place for next year's convention. Abstracts of the papers prepared by Messrs. Howe and Clapp follow:

Inductive Disturbances

Mr. P. J. Howe, of the Western Union Telegraph Company, read an extended paper on "Inductive Disturbances as Affecting Telephone and Telegraph Lines." On account of the tendency in recent years to locate high-tension lines on or closely parallel to steam-railroad rights-of-way the subject has become of increased importance to railway officials. The author defined electrostatic and electromagnetic induction at considerable length, including the well-

known factors determining the relative intensity of each. The principal characteristics of telephone, telegraph, constant-potential distribution and constant-current distribution systems were next described. Polyphase systems, with the several possible methods of connecting transformers in three-phase distribution, were described in elementary terms with the aid of diagrams, and also the single-phase system of electric traction. Harmonics of the fundamental waves of emf and current, such as occur quite frequently in transmission systems, were briefly taken up and their effect explained.

After giving some general rules for the field inspection of parallel inductive exposures, the author discussed the several known methods for remedying such disturbances, treating first the means of prevention by suitable modifications of the transmission system and then the means of restriction by modifications in the telephone and telegraph system. The means of prevention include perfection of insulation and balance of the transmission or distribution line; use of the closed loop in series distribution and static balancing of the circuit by inserting consecutive lamps in alternate sides of the circuit; transposition of phase wires; avoidance of star-connected transformers with grounded neutrals; double feeding of single-phase trolley sections from both ends, and also shortening the sections; use of the three-wire trolley system, with track as the neutral, and short-circuiting generator harmonics by means of specially tuned or resonant circuits at the generating station.

Methods of restricting inductive disturbances by modifications of the telephone and telegraph system include special attention to the insulation and balance of lines; use of special transpositions; use of twisted pairs, or cable; electrostatic shielding by means of grounded conductors; special compensating transformers, such as those employed in parallel exposures of circuits in cable along the route of the New York, New Haven and Hartford Railroad, and the use of special apparatus, such as drainage coils or resonant shunts, connected to the telephone and telegraph circuits. In general, the means of prevention sacrifice something of the efficiency of the telephone and telegraph circuits. In conclusion, the author urged co-operation between lighting and telephone engineers in applying these preventive and remedial measures to solve the problem in the way which will be least burdensome as a whole upon the general public.

Protection Against Lightning and High-Tension Currents

The author of the paper on "Protection Against Lightning and High-Tension Currents for Telegraph and Telephone Equipment," Mr. M. H. Clapp, called attention to the increasing necessity of installing efficient protective equipment on railway telegraph and telephone lines, owing in large part to the greater number of instances where such lines are paralleled or crossed by high-tension transmission lines. While the N. E. L. A. specifications have admittedly accomplished much in raising the standards of high-tension construction and thereby reduced the risks of accident and damage, there are yet many hazardous situations, and the question of protecting equipment is even more important than it formerly was. When such equipment is burned out by lightning or excessive currents the loss is twofold—first, the loss of the equipment and, second, the loss of time in use of the circuit. Last year the Northern Pacific Railway Company lost over $1,500 worth of equipment on account of burn-outs.

The author sent out to several superintendents of telegraph on the large railway systems a series of seven questions relating to their practices and experiences in the use of protective equipment. The replies, as might be expected, revealed considerable divergence in results.

Brief descriptions were then given of the standard practices of the American Telephone & Telegraph Company and the Western Union Telegraph Company, including also the use of metal blocks in open-space cut-outs, series choke coils in the line and the use of special heat coils.

The remainder of the paper was devoted to a consideration of the theory of proper protection, with a number of illustrations showing the preferred methods. The author believed it feasible to devise protective equipment against the following foreign voltages: constant-potential ungrounded circuits not exceeding 5000 volts; alternating-current series circuits not exceeding 5000 volts; direct-current series circuits not exceeding 7500 volts, and direct-current railway circuits not exceeding 1000 volts. For higher voltages the line construction should be so reinforced at places of exposure as to preclude failure, and wherever possible the lighting and telegraph systems should be adequately separated. The preferred method of protection consists of: (a) a large line fuse, (b) an open-space cut-out, and (c) a low-capacity fuse or heat coil. The heat coil or fuse may be omitted under certain conditions, more especially where telegraph equipment exclusively is to be protected. The author stated in conclusion that from his experience there is no way of losing efficiency faster than by using cheap (unsubstantial) protective apparatus.

Gasoline-Electric and Storage-Battery Cars

Mr. H. T. Bentley, of the Chicago & Northwestern Railroad, president of the association, presided at the fifth annual convention of the International Railway Fuel Association held in Chicago on May 21, 22, 23 and 24. Among the six papers presented at the convention the one on "Self-Propelled Railway Passenger Cars" is perhaps of the most interest to electrical readers. The paper, which was a very comprehensive report on the subect, was jointly prepared by Messrs. S. T. Dodd and B. H. Arnold, of the General Electric Company. A history was given of the different types of self-propelled cars used on branch lines or light traffic roads. The radius of operation of steam, compressed-air, storage-battery and internal-combustion-engine cars was discussed with a view toward the comparison of cars having the same seating capacity and tractive effort. The advantages, characteristics and operating costs of the gasoline-electric cars were discussed quite thoroughly. Satisfactory methods of testing fuel oils other than by gravity were suggested. In addition, sample examination blanks for gasoline-electric motor-car operators and inspectors were outlined. Fuel and oil performances of gasoline-electric cars operating on various roads in the United States were submitted in tabulated form with the paper.

Considerable discussion followed the delivery of the paper, in which the following men took part: Messrs. O. S. Byer, A. G. Kenyon, D. C. Buell, J. H. Tracy, F. E. Drake, J. C. Little, H. J. Osborne, J. Skelton, J. E. Hilton, E. McAuliffe and G. B. Pratt. Objection was raised against the gasoline-electric motor cars, on the ground that steam locomotives had to be kept on hand to replace them at short notice in case of breakdown. This objection was well answered by the statement that reserve locomotives always have to be kept on hand no matter what the prevailing motive power may be.

Reliability of service was another topic which interested many. Messrs. Buell, of the Union Pacific Railroad, and Hilton, of the Frisco road, practically removed all doubt concerning the reliability of service of gasoline-electric motor cars by their accounts of the service rendered the two roads which they represent. Mr. Buell believes that the gasoline-electric unit is the practical motive power for heavier traffic than that on which it is used at present. The only trouble which has been experienced with motor cars has been caused by the ignorance of the operators. Educational bureaus have overcome this difficulty to a marked

degree. Performance tests on the Union Pacific Railroad with gasoline-electric cars show a better fuel economy than with the steam locomotive. Mr. Drake gave some interesting figures on gasoline-electric motor-car performance in Hungary, Europe, and in Oklahoma. On the Arad-Csanad Railroad in Hungary seventy-two trains are operated in both directions daily. The average car mileage per year is 1,000,000 miles and total annual mileage is 5,300,000 car-miles, which, according to Mr. Drake, is considerably more than any steam locomotives in the United States are capable of. In Oklahoma the motor cars on the Muskogee Electric Traction Company's road operate 3.3 miles per gallon of fuel oil. Operating expenses and fixed charges amount to 16.4 cents per car-mile.

In a written communication from Mr. J. H. Tracy, which was read by Mr. H. M. Beck, some data were given on the performance of storage-battery cars compiled from actual practice.

Storage-Battery-Car Operation

The author claimed that gasoline or gasoline-electric cars offer the best solution to the problem of handling light, infrequent traffic when conditions call for long-distance hauls at relatively high speeds and with few stops, and that the storage-battery car "has a useful and economical field for service which is within the scope of the battery." The lead battery offers a wide field for usefulness. One hundred miles per charge at a free running speed of 30 miles per hour, with an equipment seating seventy passengers and providing a suitable baggage compartment, seems to be entirely within the range of conservative operation.

The Lewisburg, Milton & Watsontown Passenger Railway Company in Pennsylvania has been operating since early last October a storage-battery car built by the J. G. Brill Company and equipped with an "Exide" lead battery from the operation of which data have been compiled. The car in operation on this line is 34 ft. 4 in. over the corner posts, has a seating capacity for thirty-two passengers in the passenger compartment and has a baggage room 11.5 ft. long. This car is of standard construction, and while carefully designed for light weight, embodies no special features except that ball bearings are used to reduce the running friction. The car weighs 32,200 lb. complete with battery, the battery weighing somewhat less than 8000 lb.

Between Oct. 9, 1912, and April 1, 1913, the car operated a total distance of over 20,000 miles, regularly performing approximately 122 miles a day. During this time the car lost only 19 miles from the full schedule. This loss was due to a damaged charging plug which in turn damaged the car wiring. These figures, the author believes, show a reliability of operation which is certainly equal to that of the best class of apparatus in operation on the steam railroads and in excess of that which can be shown by any other class of self-propelled car. The entire care of this car, including charging the battery, cleaning, inspecting, etc., is assumed by two crews, each consisting of one motorman and one conductor, working, of course, under the general supervision of the officials of the Lewisburg, Milton & Watsontown Passenger Railway Company, which company also operates a trolley road between the three places named.

During the six months of operation mentioned above, which it will be noted covers the winter months, the consumption of this car has averaged approximately 4.25 amp-hr. per car-mile. The battery equipment consists of eighty-eight cells having a rating of 420 amp-hr., the individual cells being identical with those which have been used successfully since September, 1910, on the street cars in New York. The battery averages 170 volts during discharge in this service, which gives an energy consumption of 722 watt-hr. per car-mile. Assuming an average live load of 1.5 tons, the actual energy consumed from the battery amounts to 41 watt-hr. per gross ton-mile. The ruling grade on this line is 0.7 per cent, there being a difference of 88 ft. in level between the two termini. The number of stops averages between one and one and one-half per mile, as the car is stopped at intersecting roads as well as at the regular passenger stations of the Pennsylvania Railroad Company.

The rating of the battery being, as stated above, 420 amp-hr., and the energy consumed in driving the car averaging 4.25 amp-hr. per car-mile, a mileage capacity on one charge of the battery of nearly 100 miles is indicated.

The Central Station and the Electric Vehicle

Among the papers presented at the convention held in Boston May 20 and 21 under the auspices of the New England Section of the Electric Vehicle Association of America and the Electric Motor Club of Boston, noted in our issue dated May 24, were three dealing with the attitude of central stations toward electric-vehicle owners and the popularity of the electric vehicle.

Central-Station Service for Electric Cars

A paper was presented by Mr. L. R. Wallis, of the Edison Electric Illuminating Company, of Boston, which discussed the mutual responsibilities of the central station and the electric-vehicle manufacturer, emphasizing the point that only through the broadest co-operation can the logical development of the field be secured. Special attention was paid to the importance of caring for the service after the installation has been made, with a clear understanding of the division of responsibilities. In territories lacking adequate factory representation the central station should stretch a point to foster the industry during the waiting period, after which the volume of business will warrant the manufacturers in establishing agencies and maintenance departments in such localities. If a distinct line is drawn between the service to be rendered by the manufacturer and the central station, it appears equitable to make the division on the basis of instruction and supervision of that portion of the equipment supplied by each, the central station dealing chiefly with matters concerned with battery charging and rates, also acting as consulting engineer in case of unsatisfactory operation or excessive cost of service. Regular inspection of the electrical apparatus should also be made to insure constant service, safe and satisfactory performance. The central station can render valuable service to the manufacturer as well as the user by maintaining a department of vehicle and battery engineering, whether it consists of one or more individuals, whose function it should be to bring the prospective customer and agent together for their mutual benefit and to safeguard the interests of each after the sale has been consummated. The inception and maintenance of suitable charging stations was discussed by the author in closing.

Discussion

Mr. Eugene Carpenter, Oak Bluff, Mass., advocated co-operation with livery stables and gasoline garage owners. He favored offering a 10 per cent discount on energy sold, to cover the initial cost of the electric garage, and also billing the garage owner the same margin of profit on energy as he gets on gasoline. He recommended the education of high-school and technical graduates in the construction and maintenance of electric vehicles under central-station auspices. A vigorous discussion took place regarding the respective spheres of the central station and the manufacturer in relation to service after cars are sold. Among the speakers were Messrs. W. M. Thayer, Hartford; S. Fred Smith, Salem, Mass.; F. E. Sawyer, Salem, Mass.; Harvey Robinson, New York; J. C. Weatherby, Boston; R. W. Rollins, Worcester; J. C. Bartlett, Wood's electric garage, Philadelphia; P. E. Whiting, Boston, and J. W. Cooke, Boston. The point was made that effective

work is done at Rochester, N. Y., by a traveling electric-vehicle inspector who follows up every private electric car in the city and facilitates its proper maintenance.

Central-Station Development of Vehicle Load

Mr. W. C. Anderson, president of the Anderson Electric Car Company, Detroit, Mich., presented a paper in which the importance of low rates for energy for battery charging was emphasized and in which the possibilities of co-operation between central stations and vehicle manufacturers were vigorously set forth. He paid a tribute to the work of the Edison Electric Illuminating Company of Boston in this field and cited a recent reduction in rates from $10 to about $4 for 100 kw-hr. as an example of the practical value of the company's policy, which Mr. Anderson said is in strong contrast with the policy followed by some central stations of unprogressive tendencies. The speaker pointed out that there are localities within 50 miles of the meeting place where 25 cents per kw-hr. is being charged for service. Such conditions are utterly discouraging to the development of the electric-vehicle business along broad lines.

The author contended that central stations everywhere should afford the utmost encouragement to representative electric-vehicle dealers. Much good can be done by helping the dealer through the supply of free energy for his batteries in the preliminary development until the business begins to pay him. The central station should stand back of the electric vehicle, and if no local representative can be secured lend the weight of its influence to the solution of the commercial problem. The rates for energy should be as low as is consistent with local conditions. When the lady owning an electric car tells her friend at the afternoon tea that her last month's bill for electricity was less than $10 for about 600 miles of service, one may be sure that the friend resolves to make a strong point of this fact when she next discusses the matter with the master of the house. In closing, the author touched upon the work of the Hartford (Conn.) Electric Light Company, which maintains a battery department where owners of electric vehicles may rent batteries at a fixed cost per mile. This plan relieves the vehicle owner from investing money in battery equipment and from all responsibility regarding the care of batteries.

Discussion

In the discussion the necessity of appealing to women by handsome catalogs was emphasized. The field of the high-grade electric vehicle was pointed out, and the need of better material and closer fitting than in the gasoline car was cited as a reason for the relatively high cost of electric automobiles. Increasing demands should lead to lower ultimate prices. Among those who participated in the discussion were Messrs. C. D. Marsh, New York; F. H. Smith, Worcester;; Colonel E. W. M. Bailey, Amesbury, Mass.; F. J. Stone, Boston; J. E. Gray, Providence, R. I.; Harvey Robinson, New York; W. C. Anderson, Detroit; P. E. Whiting, Boston, and J. H. Hunnewell, Lowell, Mass. The last-named speaker emphasized that the first cost of electric vehicles and the cost of energy are not the major problems. The manner of making the sale and taking care of the customer is the vital point, and the guarantee is a most essential feature in dealing with uncertain customers.

Popularity of Electric Vehicles

In a paper on the growing popularity of the electric vehicle Mr. H. H. Rice, president of the Waverley Company, Indianapolis, Ind., pointed out that the public in ever-increasing numbers acknowledges the desirable features of the electric car and that thousands of automobile owners are looking favorably upon the electric vehicle, as shown by the large number of gas cars "traded in" for electric vehicles. The manufacturers and dealers in gasoline cars have changed their attitude of outright contempt or good-natured tolerance to recognition that the electric vehicle, both in the passenger and in the truck form, is a car which in its own field is unequaled by the gas car. According to the *Automobile*, there were in October, 1912, some 34,000 electric pleasure cars registered in the United States, while the new registration for the year was 5550, showing a gain of 20 per cent. Even these figures show that there are half as many electric vehicles in use in this country to-day as there are automobiles of all types in any leading country in Europe. The general use of high-priced gasoline touring cars for both city and country service is one of the most costly fads of the day. The modern electric pleasure car excels in luxury the most fashionable carriages of the last generation and has every advantage over the gasoline car for daily service. The man who has $4,500 to invest in automobiles will do well to consider whether he can find a better investment than a three-thousand-dollar electric vehicle and a fifteen-hundred-dollar gas car for touring. The advertising done by electric-vehicle manufacturers has always been in advance of the volume of their business. They spend a larger percentage of their gross income on publicity than almost any gasoline-car company. Consequently, at present, when many gas-car factories are running on short time, it is not surprising to find the manufacturers of electric vehicles working full time and in some cases increasing their product over last year's business. To-day there is no manufacturing industry in the country on a better basis. The field of the commercial car is practically unexplored as yet. Day in and day out the electric vehicle invariably shows the lowest cost per package handled. The author closed with a tribute to the pioneer work of the Edison Electric Illuminating Company, of Boston, and other central stations in the electric-vehicle campaign.

Discussion

Citing the growth of the electric-vehicle business, Mr. D. C. Tiffany, Boston, said that he sold four cars in the year ended in March, 1912, against twenty during the year ended March, 1913. Mr. J. A. Hunnewell, Lowell, Mass., referred to a new 60-ft. by 100-ft. concrete garage with a capacity of thirty cars. Continuous day and night service is given. Messrs. D. C. Tiffany, F. J. Stone and E. S. Mansfield also spoke briefly.

Meeting of Ohio Society of Engineers

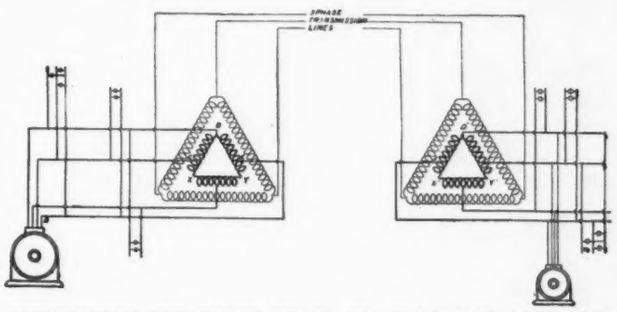
The twenty-seventh annual meeting of the Ohio Society of Mechanical, Electrical and Steam Engineers was held at Springfield, Ohio, May 22 to 24, although the usual large attendance was this year somewhat depleted by the preoccupation of many members owing to the recent floods in the State.

Mr. Evan G. Price, vice-president and general manager of the Indianapolis Switch & Frog Company, Springfield, Ohio, opened the technical program with an address on "Repairs and Welds by Electricity," describing the possibilities of the latest methods in building up broken and worn sections, reclaiming track parts, joining rails, etc. Mr. Price gave an account of the apparatus developed by his own company in which a fluxated steel rod forms one electrode of the short arc used and also supplies the material to be flowed onto the work. Later the society visited the plant and witnessed demonstrations of this method.

On Friday morning Mr. Frank T. Wyman, of the Pittsburgh Transformer Company, Pittsburgh, Pa., presented a paper on "Operating Characteristics of Transformers." Discussing the selection of apparatus of all-round efficiency for ordinary service, the author recommended a ratio of three to two between I^2R loss and core loss, in order to attain better regulation, higher efficiency at full load and

greater overloads without harm. In the self-cooled, oil-filled type of transformer, the windings require a surface of 3 sq. in. to 4 sq. in. per watt radiated, and the cases, 6 sq. in. to 9 sq. in. The windings in an impregnated transformer will run cooler than those of one not impregnated, since in the former the copper and insulation are more nearly homogeneous. Surges impose severe voltage strains on the end turns of transformer windings. The higher the reactance the less the turns through which the surge is likely to travel. Consequently, if additional reactance is provided in the form of distinct and separate coils, the transformer end turns proper will be relieved of a large percentage of the abnormal voltage rises. Such coils are of course replaceable without withdrawing the whole transformer from service. In closing Mr. Wyman described a scheme of two-phase to three-phase transformation which gives greater freedom from unbalancing with unequal loads. Both two-phase and three-phase may also be taken from the two-phase side. If the primary side of the transformer, for instance, is two-phase, then four times the rated capacity of the transformer in power may be taken as three-phase at the same voltage from the same side, or vice versa, without overloading the transformer. Two-to-three-phase transformers of this type have been built as simple units.

A paper by Mr. Frederick W. Ballard, engineer of construction for the city of Cleveland, Ohio, discussed district steam heating with high-pressure steam and described the plans for the new municipal system of this type now being installed at Cleveland. In large central-station systems, declared the author, it is not economical to run engines



CONNECTIONS FOR THREE-PHASE TO TWO-PHASE OPERATION

non-condensing in order to secure exhaust steam for heating, since hardly half the power of the steam is then available at the engine. But the greatest advantage of the high-pressure scheme lies in its reduced investment, since smaller sizes of pipe are necessary. The heat loss from the mains is also less, owing to higher flow velocities and smaller radiation surfaces of the underground mains. For the 8200 ft. of lines already installed at Cleveland the cost of equivalent low-pressure mains would have been nearly two and one-half times the present outlay, or the difference between $65,549 and $167,330. This $101,781 difference in investment would add at least $10,000 per year to the fixed charges of the low-pressure system. For a 25,000-hp boiler plant, generating 1800 kw by non-condensing units and devoting the remaining 80 per cent of the steam to heating, the saving would be $5,250, on a basis of 100 per cent load-factor. Even with such an assumption this operating saving represents, however, only one-half the increased investment cost of the low-pressure system. Other disadvantages of the exhaust-steam system, as stated by Mr. Ballard, are the lack of coincidence between heating and power loads, poor economy of non-condensing apparatus when steam heating is not required, and the high radiation losses from the large mains.

On Friday evening Mr. R. Hastings Probert, works manager for the James Leffel Company, Springfield, Ohio, read a paper on "Interesting Foundry Experience with Semi-Steel Mixtures; the Molds and Cupola Charges."

During the days of the sessions inspection trips were made to many of the interesting industrial plants near by. Among those visited were the works of the Indianapolis Switch & Frog Company, the Lagonda Manufacturing Company, the Kelly Motor Truck Company, the Superior Gas Engine Company, Bauer Brothers, the Foos Gas Engine Company, the Robbins & Myers Company, the International Harvester Company, the James Leffel Company, the Hoppes Manufacturing Company and the Springfield Light, Heat & Power Company. A dinner was tendered to the delegates at the Commercial Club rooms Friday evening, after which the ladies were entertained by a theater party.

Southwestern Electrical Association Papers

Among the papers presented at the convention of the Southwestern Electrical and Gas Association held in Galveston, Tex., on May 21, 22, 23 and 24, to which attention was called in our issue dated May 3, were several of interest to central-station operating men. Brief abstracts of these papers are given below.

Public-Service Rate Making and Regulation

The rates charged by public utilities formed the subject of the paper by Mr. W. J. Norton, of the rate research committee of the N. E. L. A., and he insisted that these should be sufficient to bring to the utility a fair return on the money invested in it. He drew a marked distinction between the various utilities and claimed that, in view of certain factors connected with the business of supplying electrical energy that are entirely different from any encountered in the other utilities, certain practices not tolerated in connection with the gas or water-supply business are necessary to the successful operation of the electric-supply business, the one particularly mentioned being the right to promulgate "development rates." The general tendencies in the line of regulation by commissions, among the various states, were next taken up, the author being of the opinion that so far there had been a marked disposition shown to deal fairly with the utilities. He announced himself as favoring uniform rate schedules wherever possible, and, more than that, he said that voluntary rate reductions, where they had been found possible and been made, had reacted greatly to the advantage of the companies making them. This, he claimed, had been manifested in two ways, first, by an increase in popularity, and second, by a sufficient increase in business to make earnings fully as large as, or larger than, they had been before the reduction. Mr. Norton closed his paper with the statement that in his opinion, although the good will of the public has not been allowed to be capitalized, it is a very considerable part of the assets of any company and should be cultivated constantly against a time when it might prove of greater value than the physical property of the company.

Standard Accounting for Texas Public Utilities

An exceptionally able paper was rendered on this subject by Mr. H. E. Gordon, president of the Public Accountants' Society of Texas, in which he emphasized the necessity of study and co-operation in the planning of a uniform system of accounts. This, he said, would serve the best interests of both the large and the small companies and, in the event of the formation of a public service commission in Texas, would perhaps save the utilities from having to conform to a system of accounts recommended by such commission that would fail in many respects to give to the utilities themselves the information concerning their business which is most important for them to have. Mr. Gordon's paper brought out in plain terms, easy to understand, the theories back of many of the accounting methods, and it discussed at length several of the more important items in public-utility accounts.

Prevention of Boiler Scale

That more careful attention should be paid to the quality of the boiler-feed is the claim of Prof. A. C. Scott, of Dallas, and in his paper he cited numerous instances where the failure to do so had resulted in damage to apparatus, if not in injury to employees. The three possible sources of boiler-feed water in Texas were stated to be rivers, lakes and wells, and in each of these cases there is more than an even chance that the water will not be fit for use in a boiler without some sort of treatment. Brief description was given of the four most generally adopted methods for effecting a partial or entire purification of the water so that scale would be reduced. For large plants the "cold process" was favored, but for smaller plants the use of boiler compounds in the proper proportion was thought to be sufficient.

The Commercial Department in the Gas Business

Advocating the establishment of a commercial department by those operating gas utilities, Mr. R. E. Turrentine, of the Houston Gas & Fuel Company, proceeded to outline the several ways in which such a department could co-operate with the other departments of the business to the great benefit of both the public and the company. By accelerating the work of the shop and installation departments, and by making the men in them feel that they are part of the organization, the general efficiency of their work could be increased. By having the meter-reading and inspection departments under the control of a commercial department, the author claimed that an increase in accuracy could be obtained and quicker and more effective action secured on complaints as to inaccuracy of meters or readings. Co-operation between the accounting and collection departments and the commercial department would, it was stated, enable the company to keep track of bad accounts and also to make an extra effort to land desirable customers. Mr. Turrentine favored the handling of complaints by personal calls instead of by letter, as being more satisfactory to the customer, and for the same reason he thought that the employment of demonstrators to see that stoves and other apparatus are properly installed and understood was a wise policy.

Window Displays of Appliances

Mr. E. W. Jones, of the Galveston Gas Company, made a plea for more extended use of window displays for appliances. He said that a window display should be made a "silent salesman," and to do this he maintained that it should first be made to attract the attention of the passer-by and then to arouse his interest so that he would either enter to find out more about the articles displayed at that time or later on or else would carry away such a strong recollection of the display that when approached later by a solicitor he would still retain a distinct impression of it. Errors to be avoided, according to the author, are the overcrowding of the display, the insertion of too much decorative effect, poor lighting, too little explanation and too few changes. He contended that the whole burden should not be put on the window, but that the store should co-operate to the extent of being open and ready to supply the information required by prospective customers attracted by the window. He thought that a fine window display is a waste of money unless the store is open and ready for business at the same time.

Advantages of Oil-Engine Drive

A very brief paper by Mr. A. L. Chase, of the Clarendon Light & Power Company, gave data which he considered as favoring the use of fuel-oil engines for driving the generators in small stations. In connection with the remodeling of a small steam station owned by him and operating in a town of about 2500, he stated that it was found that the fuel cost was reduced from $225 to $164 per month by the installation of oil engines of rating equivalent to the steam equipment at first used, and this in spite of the fact that the service with the present equipment is a twenty-four-hour one while formerly it was only a six-hour to nine-hour service daily. The initial cost of oil-engine equipment, he said, was about $65 per hp for this type of engine, but he claimed that this comparatively high first cost was more than offset by the difference between five cents per gallon for distillate and $2.25 to $4.50 per ton for slack coal delivered.

Protection of High-Tension Circuits and Apparatus

Means for protecting employees and apparatus from injury due to accidental contact with high-tension conductors or to lightning phenomena, natural or artificial, were described simply and clearly in the paper of Mr. E. E. Nelson, of the Northern Texas Traction Company. His first advice was that in the design of a generating station the exact placing of all cables, especially those carrying high tension, should be a matter of preliminary design and that low-tension and high-tension lines should be kept strictly separate, the latter being isolated as far as possible. Oil switching and remote control, he said, were modern methods for reducing the danger incidental to the opening of high-tension circuits. The various classes of lightning arresters at present available and also the use of large choke coils to reduce the damage from surges due to lightning or short circuits were touched upon. For the safety of employees working on transmission or other high-tension lines the precaution of having the lines grounded by instructions of the responsible party and only cut in again by special order of the same party was recommended.

Problems of the Small Central Station

In few words the paper by Mr. E. D. Kelly, of the Terrell Electric Light Company, gave some glances from behind the scenes at the problems which the operator of a light and power station in a small town has to face. The lighting load is far from being a money-making one, considered alone, and it possesses a poor load-factor. It is not possible in the small plant to get the same degree of exactness in cost accounting and in division of labor possible in a large station, and so the advantages incidental to these refinements are not attainable. The salvation of these small plants lies in the introduction of energy-consuming devices for domestic use and in the making of attractive rates for special service, such as for store illumination. The station which furnishes the auxiliary service of wiring, repairing and supplying of fixtures and appliances is in a position to win customers by making this service particularly satisfactory. Competition from municipally operated plants is often met with and can be best overcome by maintaining a superior service, by instituting an active publicity campaign and by seeing that every employee of the station uses tact and courtesy in all dealings with the public.

Sanitary District Considering an Increase in Rates

A committee of which Mr. Thomas M. Sullivan is chairman has been delegated by the Board of Trustees of the Sanitary District of Chicago to report on the equitable distribution of construction costs before new rates are fixed. This action has been required because of the fact that the Sanitary District operates two departments, which are interlinked because of construction details—one for disposing of Chicago's sewage by the Drainage Canal, and the other for generating electricity by the incidental water-power. In 1900 water was turned into the canal. Three years later a permit was granted to enable the Sanitary District to build a water-power plant at Lockport. The two activities of the District are so closely allied that it has been difficult to apportion construction costs fairly. During

an investigation which was conducted by the engineering committee of the trustees, it was found, it is said, that $1,537,051 had been erroneously charged to engineering accounts in 1908. This amount, it was contended, was rightfully chargeable to the electrical installation. By transferring the charge it was considered justifiable by the committee to raise the rates on electric service so that equitable returns could be realized. Considerable discussion developed at the meeting of the engineering committee of the Sanitary District on May 14, when it was suggested that the rates which the city of Chicago pays for electricity be raised. A majority of the committee favored an increase. Mr. Wallace G. Clark, one of the trustees and the minority leader in the discussion, expressed himself as being against the proposal. Since a resolution has been recommended by two City Council committees asking that 15,000 flame-arc lamps, or their equivalent, be installed by the Sanitary District, some of the minority declared that a raise in rates would cause the Commonwealth Edison Company to compete for the business. The matter has been referred to the Sanitary District attorney and engineers.

Proposed Revision of Rates in Chicago

After spending several months investigating the Commonwealth Edison Company's properties and service in Chicago and compiling data on operating and maintenance charges, Mr. Ray Palmer, city electrician, and Mr. J. E. Traeger, city comptroller, submitted a joint report to the City Council committee on gas, oil and electric light on May 15. This report is to serve as information in relation to the proposed revision of the electric-service company's rates under the contract ordinance under which the company operates. The report comprises over 100 pages and in it the city electrician made several recommendations concerning the future rates and provisions for studying the service rendered the public. He suggested that hereafter the public be represented on the appraisal board and that a bureau for handling complaints about electric service be established. Several schemes for reducing retail rates are proposed. In one the rate is 10 cents per kw-hr. for the first hour's daily use of maximum demand, 5 cents for the second and 3 cents for all excess, lamps and motors being placed on the same schedule, thus eliminating the extra investment in maximum-demand meters and watt-hour meters. Another proposal is to reduce the primary rate for both lamp and motors below a 10-cent maximum, and to reduce also the number of hours' daily use of maximum demand before the secondary rate is effective. It is also recommended that special discounts be eliminated. The suggestions in the Palmer-Traeger report are tentative, and the subject will undoubtedly be discussed at length before any changes in the rates are actually made.

Annual Report of Marquette (Mich.) Light and Power Commission

The twenty-fourth annual report of the Light and Power Commission of the city of Marquette, Mich., for the fiscal year ended March 11, 1913, which has recently been published, contains much of interest to central-station managers. In order to bring out the full significance of the report it seems appropriate to give a short description of the plant.

Description of Plant

Water storage is provided by a 23-ft. dam which is 500 ft. long, with a concrete corewall, at Silver Lake. The dam is designed to carry a head of 20 ft. Besides the concrete head-works there are earth embankments on either side, 16 ft. wide at the top, with a slope of one and one-half to one. There is a 4-ft. by 4-ft. opening in the bottom of the dam to sluice water as needed for the plants and a 5-ft. by 9-ft. sluice in the top of the dam to pass logs, debris, etc.

No. 1 dam is 16 ft. high and 250 ft. long, of concrete throughout. A 6-ft. wooden penstock 100 ft. in length delivers water to a pair of 40-in. Leffel turbines of the horizontal type, rated at 300 hp and working under a 32-ft. effective head. This unit is belted to a 300-kw, 60-cycle, 2300-volt generator. No. 2 dam is a concrete structure 200 ft. long and 60 ft. high, diverting water to a 6-ft. steel penstock 2700 ft. in length. At the plant there are two 25-in. horizontal turbines directly connected to a 550-kva, 60-cycle, 2300-volt generator, working under 94 ft. effective head, and a pair of 23-in. special Leffel-Sampson horizontal-shaft turbines directly connected to a 1250-kva, 60-cycle, 6600-volt generator. The system is two-phase throughout, and the transmission pressure is 6600 volts.

Connected Load

The number of installations served was given as follows: Number of residences, 1919; number of business places, 482; number of motors, 139; total horse-power of motors, 1700; number of electric flatirons, 1652; number of multiple-arc lamps, 50; number of Nernst lamps, 35; number of street arc lamps, 154; peak demand in kilowatts, 1000.

For the last fiscal year the results of operation are given in condensed form in Table I.

TABLE I—REVENUE AND EXPENSES

Revenue from street lighting		$8,846
Revenue from other municipal lighting		1,609
Revenue from residence lighting		28,278
Revenue from business lighting		21,178
Revenue from motor service		9,126
Total revenue		$69,037
Expenses:		
Manufacturing expense, operation	$6,546	
Manufacturing expense, maintenance	1,229	
		$7,775
Transmission and distribution, operation	$1,346	
Transmission and distribution, maintenance	1,472	
		2,818
Commercial expense, operation	$3,343	
Commercial expense, maintenance	45	
		3,388
General operating expense		6,673
Total expense		$20,654
Net earnings		$48,383

The disposition of the net earnings was accounted for as shown in Table II.

TABLE II—DISPOSITION OF INCOME

Net earnings from operation	$48,383
Profits from installations and sales of merchandise	421
Other income, net	272
Total income	$49,076
Payment of bond interest	3,684
Net income	$45,392
Bonds refunded	22,500
Balance	$22,892
Cash surplus on hand March 12, 1912	6,018
Total surplus	$28,910
Invested in plant extensions during the year	24,797
Final surplus March 12, 1913	$4,113

During the year the commission borrowed $10,000 from the Board of Fire and Water Commissioners and invested it in plant extensions, bringing the total for the year up to $34,797. This loan has been repaid, however, and the commission expects to finance extensions for the current year out of income.

Table III shows the total cost of the plant to March 12, 1913, classified.

TABLE III—PLANT INVESTMENT

Land	$30,648
Power house and dams	113,389
Wooden buildings (three)	3,881
Penstocks, waterwheels and auxiliaries	67,384
Generators (three)	23,090
Poles and fixtures	17,181
Copper conductors	60,242
Arc lamps	7,703
Transformers	38,830
Meters	30,057
Motors	1,518
Substation building	4,210
Water-works and substation	1,383
Miscellaneous	2,162
Total	$401,678

Since 1900 a total of $52,193 has been expended on replacements and extraordinary repairs and charged to expenses; of this amount $44,644 represents replacements.

Return on Investment

Allowing for 5 per cent depreciation, which is probably more than ample, the following showing is made for return on the investment: Net earnings from operation, $48,383; depreciation, $20,084; balance, $28,299, the percentage of return on investment being 7.05.

Of course, this figure leaves out of consideration any capital allowance for stores and supplies on hand and working capital. Considering that the city borrows money at the rate of 4½ per cent, however, there is evidently a net profit in the operations.

TABLE IV—ENERGY GENERATED AND SOLD

	Kw-Hr.
Total energy generated at plants	2,689,800
Energy purchased	112,875
Total output	2,802,675
Used for street lighting	280,790
Used by plant	59,424
	340,214
Transmitted to substation	2,462,461
Received at substation	2,311,020
Loss in transmission (6 per cent)	151,441
Residence consumption	462,350
Business consumption	568,010
Motor consumption	644,804
City buildings and parks	40,050
	1,715,214
Loss in distribution (26 per cent)	595,806

The commission in its report presented a tabulation of unit costs based on station meter readings, which is reproduced in Table V.

TABLE V—UNIT COSTS

	Cents per Kw-hr.
Manufacturing	0.00277
Transmission and distribution	0.00105
Commercial expense	0.00120
General operating	0.00238
Total operating	0.00740
Average receipts	0.03450

The load-factor for the year was given as 35 per cent. No data were given to show the source of funds from which the plant was built, except that $71,000 of bonds bearing 4½ per cent interest are now outstanding. These fall due serially up to 1917.

Massachusetts Legislative News

Governor Foss has vetoed Senate bill No. 415, relative to the issue of stock and bonds by electric-light, gas and power companies, which provided that bonds might be issued by such corporations to the amount of twice their paid-in capital without the necessity of securing such bonds by mortgages. Street-railway companies also came within the provisions of the bill through their use of the public highways. Chapter 725 of the Acts of 1912 permits railroad corporations to issue bonds secured by mortgages to the amount of twice the paid-in capital. In his veto Governor Foss points out that an important purpose in the existing limitation upon the amount of bonds and preferred stock is to secure for the corporation the benefits resulting from the active interest of those possessing a substantial share in the securities; that a large interest responsible for the actual management tends to increase the security of the property for all classes of investors, and that with rare exceptions these Massachusetts companies are financed under existing laws by the issue of a single class of stock and not at all by bonds. The Governor further says that the companies are not likely to need such legislation for the promotion of the public interest unless hereafter, through the issue of an undue burden of securities or through mismanagement, their stock-issuing credit shall become impaired. The veto points out that if the securities of these corporations are weakened by permitting inflated issues of imperfectly secured bonds, a high interest rate will have to be paid on the bonds, to which the public must contribute through increased rates and poorer service.

Limitations of Franchises

The Crawford Electric Company was organized in 1897 for the purpose of generating and selling gas and electric service in the counties of Knox and Waldo, including the town of Union, Maine, but had not exercised that privilege. In 1911 the Knox County Power Company was chartered to supply the same service in the same territory, but it also had not exercised the privilege. In the latter part of 1911 Hollis M. Shaw received a permit from the town of Union to erect an electrical distributing system in that town and subsequently supplied electricity to it for lighting and industrial purposes. A bill was brought by the Crawford Electric Company against the Knox County Power Company and Hollis M. Shaw, and application was made for an injunction restraining them from making or supplying electricity for lighting and industrial purposes in the given territory. The case was tried before the Supreme Judicial Court of Maine, and the bill against each of the defendants was dismissed (86 A. 119). The Knox County Power Company was shown to have no intention of engaging in that line of business in the territory in question and, in dismissing the bill against Hollis M. Shaw, Judge Cornish rendered the following opinions: (1) When a corporation has been organized under the general law to make and sell electricity for lighting and mechanical purposes no other corporation subsequently organized may, except by special legislative act, undertake to make and supply electricity for the same purposes in the same territory, but this prohibition does not extend to individuals. (2) There is a distinction between a "franchise" and a right or "power." The former represents a privilege which can be exercised only through legislative grant, as in creating a corporation. But the right to do certain things under such grant is a "power," and the right to make and sell electricity is an inherent power of a natural person, the exercise of which would not be usurping a public franchise. (3) The Legislature, by virtue of its control over public roads of the State, may grant to a person or a corporation authority to erect lines on such roads, or it may delegate that power to the officers of the several towns.

Competition and Municipal Regulation

In a recent opinion delivered by the United States Supreme Court in the case of the Madera (Cal.) Water Works versus the city of Madera it was held that, although a private water company might be serving a community under municipal regulation of rates, the act or power of regulation carries no express or implied contract that the municipality shall not construct its own water-works and engage in competition, even though the company may hold an exclusive franchise. This opinion, however, is founded upon the presumption, which amounted in this instance to fact, that when the private company built its works the constitution of the State authorized cities to build water systems regardless of the existence of such private systems. Therefore the owners of private systems took the attendant risk. Although the court said that it is impossible not to feel the force of the plaintiff's argument as a reason for placing a different construction upon the state constitution, so as to avoid the result of double regulation with its anomalous situation, the contention arrives too late. There is no pretence that there is any express promise to private capital that it shall not encounter subsequent municipal competition. The original action was brought against the city of Madera by the water company to enjoin municipal competition, under an appeal to the Fourteenth Amendment, but the Circuit Court sustained a demurrer and dismissed the bill. The plaintiffs then took an appeal, with the result announced above.

Public Service Commission News

New York Commissions

The Public Service Commission, First District, New York, has approved the application of the Consolidated Gas Company for the right to acquire the common and preferred shares of the New York & Queens County Gas Company and of the New York & Queens Electric Light & Power Company.

Maryland Commission

Action that may mean a sweeping investigation of the condition of electric wires in Baltimore has been taken by the Maryland Public Service Commission, following the death of George C. Cox, who was killed not long ago at Maryland Avenue and Russell Street by coming in contact with a feed wire. Chief Engineer Charles E. Phelps and Assistant Engineer Charles G. Edwards of the Public Service Commission report that four and possibly six companies have wires crossing at or about that point. It is pointed out by them that the construction of the cross-overs is not up to the standard and that immediate steps should be taken to prevent a recurrence of the accident mentioned. There are also two railways crossing at this point. Copies of the report have been sent to all the companies involved, and it is probable that the investigation will be extended to other points where similar conditions obtain.

Ohio Commission

The Ohio Public Service Commission has set aside the ordinance of the Toledo Council fixing the rate for artificial gas at 70 cents per 1000 cu. ft. and has ordered that a new rate be made not in excess of the old rate of 95 cents. The commission, after investigation, declared the new rate unjust and unreasonable. An investment in gas equipment of $1,000,000 was claimed by the company. The commission found that the company had an investment of $1,120,000, but that much of the equipment is useless. A valuation of $973,000 was placed upon that which is necessary, but it was found that last year the net return on this was less than 3 per cent. The company had asked that a rate that will yield a return on the investment be made.

Current News Notes

City Electric Plant Buys City Bonds.—An unusual event took place recently when the South Norwalk (Conn.) city electric works purchased, at a profit, some $20,000 of city of South Norwalk bonds. This plan of selling city bonds to municipal plants, besides being a practically new system of municipal business, will, if continued, eventually clear South Norwalk of debt, save perhaps for a sum which it will in reality owe itself.

* * *

Louisville Contractors to Attend National Convention.—The Louisville Electrical Contractors' Association has decided to attend the annual convention of the National Electrical Contractors' Association July 15-20 in a body, and expects to make a big showing there. The convention will be held in a neighboring city. In view of the activity of the Louisville body in association work it is reported that one of the leading contractors of the Kentucky metropolis is to be chosen to fill an executive position of importance at Chattanooga.

* * *

Cannot Charge a Flat Rate.—The Ohio Supreme Court has handed down a decision in the case of the city of Springfield against the Springfield Light, Heat & Power Company to the effect that the company cannot make a charge of $1 per month for service in violation of an ordinance which fixes the rate at 8 cents per 1000 watts as the legal charge to be made. This was in the nature of a service charge when the consumer used less than 12,500 watts per month, and the decision, therefore, in a general way covers the practice some companies have made of charging a fixed sum for service up to a certain amount, after which the rate agreed upon is applied.

* * *

Telephones in New York.—In London there are 235,000 telephones, in Berlin 210,000, and in Paris 92,000. The three leading cities of Europe combined have but a few more telephones than New York City alone. On Saturday, May 24, the half-million mark was passed, and to-day New York City has more than 500,000 telephones linked together in a system that requires 1,500,000 miles of wire and sixty-seven telephone exchanges to make it the most complete and up-to-date system in the world. Through the telephone exchanges in New York City over 2,100,000 calls are sent daily. In spite of the difficulties of establishing an effective system of intercommunication, New York's telephone system has enjoyed a rapid growth. The first telephone was installed in 1878. In 1900 there were 56,000 telephones, in 1905 there were 190,000, and in the last eight years that number has been increased to over 500,000.

* * *

Existing Patent System Upheld by Manufacturers.—In an address before the convention of the National Association of Manufacturers, May 21, at the Hotel Pontchartrain, Detroit, Mich., Mr. Gilbert H. Montague, of the New York bar, assailed the Oldfield bill and other efforts at patent reform as endangering the present satisfactory and useful system on which the industrial prosperity of the country is foundationed. Mr. Montague insisted that the Sherman law, properly administered, will cover all the points in the Oldfield bill and declared that any tendency to restrict invention must undermine American supremacy in the industrial arts. At the present time, he pointed out, the 35,000 United States patents being issued annually constitute more than one-third of those granted by all the countries of the civilized world. Indeed, American patents exceed in number all those issued by Germany, Great Britain and France taken together. Forty years ago, said the speaker, an effort was made to amend the United States patent system so that anyone by paying a fixed royalty to

the patentee might carry on the manufacture of an invention, but the perils of such an industrial policy were even then discovered in time to prevent Congressional enactment of the plan.

* * *

Vertical Versus Horizontal Turbine Units in Flood Times.—In spite of the tendency of modern design away from the vertical type of turbo-alternator in favor of horizontal units, operators of power plants in the Ohio districts recently devastated by floods did discover one advantage of the former type when the waters rose in their plants. The horizontal units were in many cases totally submerged, and their generators required a tedious process of drying out before they could be started up. The electrical parts of the vertical machines, on the other hand, were well above the flood waters, so that when the tide receded it was necessary merely to scrape the mud off the turbine casing and valve mechanism and start operation again.

* * *

Voltage Regulation in Tennessee.—In the Knob country of Tennessee there is a small electric-lighting plant which is operated during the early morning hours by the coal-black negro fireman who has received instructions in the simple duties of keeping the engine going until the engineer comes on at daylight. Especially was it urged upon the dusky attendant that he must keep the voltmeter needle exactly on the 110-volt division of the scale. After experience with the field rheostat, the responsibilities of his task began to weigh upon the darky and he cast about for some way of keeping the pointer from straying from its authorized position. Finally he solved the problem, and the next morning the startled engineer found a nail driven into the voltmeter scale with the pointer fixed hard and fast to its approved indication.

* * *

Canadian Telephone Statistics.—A copy of telephone statistics of the Dominion of Canada just issued shows that the total number of telephones in service in Canada is 370,884, 212,732 common-battery and 158,152 magneto. During 1912 there was an increase of 37,738 in the number of telephones operated by common battery and an increase of 30,387 in the number operated by magneto. The total number of miles of wire is given as 889,572. This is divided into urban and rural as follows: urban, 636,961; rural, 252,610. This indicates that there is one mile of telephone wire in use for every 8.1 of the total population of the Dominion and one telephone for every 19.3. There was one telephone for every 2.3 miles of wire. The class of wire used was as follows: Galvanized, 271,191 miles; copper, 20,096; overhead cable, 232,393; underground cable, 364,875; submarine cable, 1,015. The aggregate capital expenditure in telephones is now placed at $46,276,851, though the cost of real property is placed at something over $10,000,000 beyond this figure. This indicates a capitalization of $124.75 per telephone in use. The gross earnings from all telephone companies for the year amounted to about $12,250,000, as compared with a little over $10,000,000 the previous year. Operating expenses were 74 per cent of gross earnings as compared with 69.32 for the previous year. Gross earnings amount to $33.90 per telephone in use, or $13.79 per mile of wire.

* * *

Transmission of Heat Into Steam Boilers.—An investigation of the transmission of heat into steam boilers is one of several researches now being carried on by the Bureau of Mines having for their object the determination of methods by which the mineral fuels of the country may be more efficiently used. The results of the bureau's investigations indicate that the conductivity of boiler plates is so high that present steam capacities can be tripled and quadrupled by forcing over the heating surfaces three or four times the weight of gases now passed over them. By employing well-designed mechanical draft apparatus this greater weight of gases can be forced through the boilers at comparatively small operating cost. In this way it is possible to increase the capacity of many of the present boiler installations without much reduction of efficiency, and by proper arrangement of the heating surface the efficiency can be raised somewhat. In a 180-page bulletin Messrs. Henry Kreisinger and Walter T. Ray present the results thus far obtained in the investigations which the bureau is conducting. The subject matter has been treated under five heads. Part I is introductory and contains an exposition of the path of heat travel from the source to the water within the boiler. It contains also a dissertation on boiler efficiency, with general deductions on the methods of increasing efficiency and output. Part II presents the original investigations made by the steam engineering section of the United States Geological Survey, which consist mainly of about 300 tests on small laboratory multi-tubular boilers. Part III comprises a historical review of the work done by other investigators, including the writings of Messrs. Osborne Reynolds, John Perry, Dr. Nicolson and E. Stanton, of England. Part IV contains a mathematical discussion of the physical laws governing the three modes of heat transmission. In Part V the application of the laws of heat transmission to steam boilers is taken up, and also the possibility of improving the performance of existing boiler installations by special arrangements of baffles and grates. It also presents a few instances where the principles previously treated have been successfully applied, and it concludes with a summary of the significance of surface combustion as applied by Professor Bone to boiler heating.

* * *

SOCIETY MEETINGS

The Colorado Electric Light, Power and Railway Association.—The eleventh annual convention of the Colorado Electric Light, Power and Railway Association will be held in Denver during the week of Oct. 6, in juxtaposition with the electrical and industrial exposition under the auspices of the Colorado Electric Club. The secretary is Mr. Thomas F. Kennedy, 900 Fifteenth Street, Denver.

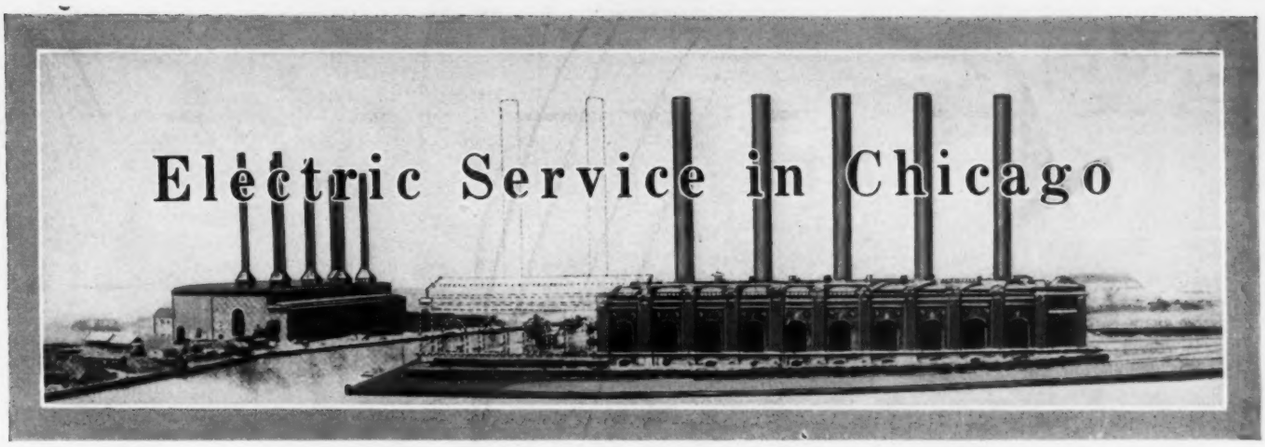
* * *

Rejuvenation at Louisville.—Arrangements are being made by Louisville (Ky.) members of the Jovian Order to hold a rejuvenation in that city on June 4, when a chapter of the national body will be formally instituted. Mr. Ell C. Bennett, Mercury of the national organization, was recently in Louisville arousing interest in the matter, and Mr. Carl A. Klemm, manager of the Louisville office of the Westinghouse Electric & Manufacturing Company, statesman in that territory, has arranged several informal dinners which have been held with a large number of electrical men in attendance.

* * *

Annual Meeting of Credit Men.—The fourteenth annual meeting of the National Electrical Credit Association will be held at the University Club, Chicago, commencing at 10 a. m. on June 4. There will be a luncheon served at the club, a meeting of the national board in the afternoon and an automobile ride through the parks of Chicago, ending with a dinner at one of the clubs at night. Reports will be received from the New England Electrical Credit Association of Boston, the New York Electrical Credit Association, the Philadelphia Electrical Credit Association, the Chicago Electrical Credit Association and the Pacific Coast Electrical Credit Association, together comprising the national body. Mr. George J. Murphy, treasurer of the Pettingell-Andrews Company of Boston, is president; Mr. John H. Dale of the Dale Company, New York, is vice-president, and Mr. Frederic P. Vose, Chicago, is secretary and treasurer.

Electric Service in Chicago



CONSIDERED from the viewpoint of men interested in the manufacture, distribution and sale of electricity, Chicago stands in a class by itself. So considered, it is perhaps the most interesting large city in the world—the one where the methods employed in electrical merchandising can be studied with the greatest profit. The truth of these statements is widely recognized, and a dispassionate survey of what has been accomplished reveals the facts on which the conclusions are based. It should be instructive to review some of these facts briefly at a time when the 1913 convention of the National Electric Light Association directs renewed attention to Chicago.

What Has Been Accomplished in Chicago

The Commonwealth Edison Company, which owns and operates the great electric-service system of the city, has a greater output than any other source of electricity supply in the world under one ownership. It has more customers than any other single source of electric-service supply. It has been a pioneer in bold engineering development to reduce the cost of production. It was perhaps the first to realize the importance of massing of production, diversity of output and effective merchandising. It has possibly the most modern generating stations to be found in this country or in the world. It has reduced its rates voluntarily to an extent probably unequaled elsewhere. In welfare work for employees it has been a leader. It has stood fearlessly for years for the economic principle of monopoly in the electric-service utility and has offered itself as an exemplar. Few electric-service companies, if any, pay more money annually into the public coffers; few have more moderate rates, and perhaps none selling energy as cheaply returns as much money on the dollar invested. Furthermore, few large public utilities of any sort have such a favorable record of amicable relations with the community served and recognize so unequivocally the justice of the principle of fair-minded regulation of monopoly on behalf of the public.

Chicago is a strenuous city, not without its defects, but it is indeed fortunate in the character of electric service it possesses. This would seem to be recognized by the National Electric Light Association, for of its thirty-six conventions, seven, including the first one in 1885 and that of the present year, are Chicago conventions. No other city has welcomed the association so often.

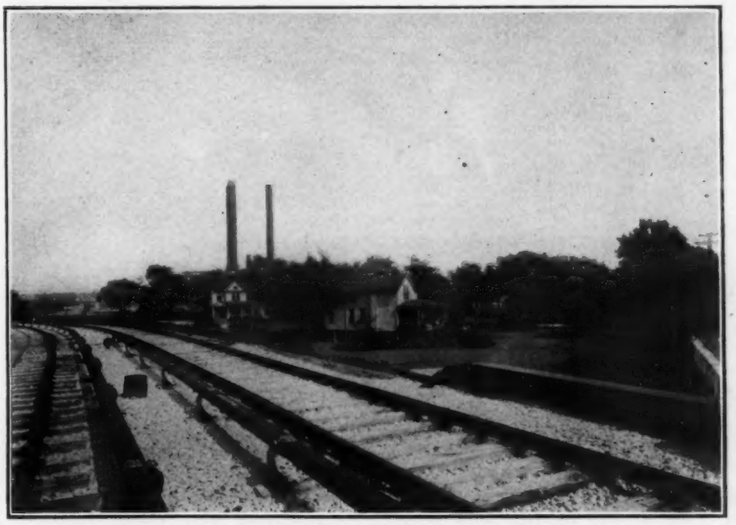


FIG. I—SURROUNDINGS OF THE NORTHWEST GENERATING STATION

The Record Not the Result of Accident

Such results as have been attained in the electric-service industry in the convention city of 1913 cannot have been the result of accident. To be sure, Chicago is a large and progressive city, peculiarly receptive to new ideas and still retaining something of that civic zeal which resulted in the White City of 1893, now a beautiful memory. It offers a good market for the sale of electricity. But there must be good goods, good service, as well as good opportunity. It would seem to be evident that there must have been an understanding of the fundamentals of the business—study; prompt grasp of new principles; courage to face large undertakings; faith in the future; correct financiering and business methods; the mutual respect and intermingling of engineering and salesmanship; the economies, gradually achieved, of large output, concentration of production and diversified demand, and an organization of men of brains and spirit—to achieve the record that has been made. Such has been, in truth, the case.

But the main driving force was and is one man—a big-thinking, far-seeing man—who came to Chicago in 1892. To Mr. Samuel Insull, president of the company since the date mentioned, must be given the recognition of having built up what may be fairly considered as the premier electric-service organization of the world. This administrator has lieutenants of exceptional ability, force and breadth of view—men who are loved and admired—but these men will be the first to testify that Mr. Insull has been the genius of the organization; that to his robust intellectual vigor, his grasp of fundamentals, his combination of boldness and prudence, his personality and his ability to inspire others with enthusiasm and the broader outlook, the success of the enterprise is mainly due.

Nearly one-fourth of the earnings of the company from the sale of electricity are due to receipts from rail-

way companies supplied with energy for propelling cars as well as for lighting and heating. This is an outstanding central-station achievement, but it will not do to ascribe the success of the company to this fact alone. Consider the number of small residence customers, the widespread use of electrical energy for industrial purposes, both at wholesale and at retail, the voluntary reduction of rates,

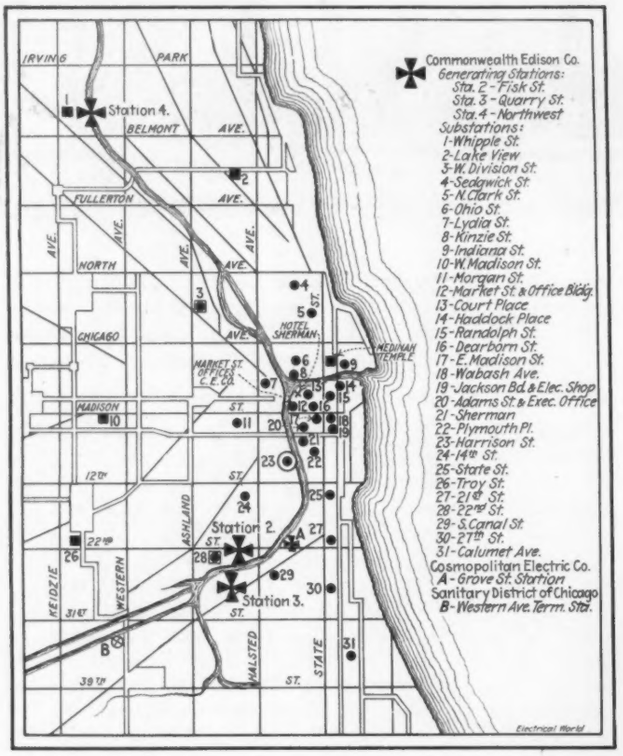


FIG. 2—SKELETON MAP OF CENTRAL PORTION OF CHICAGO, INDICATING POINTS OF ELECTRICAL INTEREST

the satisfactory relations with the public and the satisfactory returns to the stockholders through a long period of years, and the engineering achievements of the company. These and many other factors enter into the whole result.

What is said here is not intended as a mere panegyric of any system or any man. The idea is to give some idea of what has been accomplished in Chicago in the hope that the recital may be helpful. As a matter of fact the saturation point of electric service in Chicago is a long way off. It has been estimated that the Commonwealth Edison Company has secured possibly 35 or 40 per cent of the possible electricity-supply business of the city at the present time. Some companies in smaller cities furnish a larger percentage than this. But the effort to advance is unceasing. Both in reducing the cost of production by utilizing the most modern engineering methods and in securing a wider field and a greater demand for the product the company is steadily pressing ahead. The principal competitiors of the Commonwealth Edison Company are isolated plants, the so-called "block-lighting" plants and the Sanitary District of Chicago.

So many articles have been published in the *Electrical World* relating to the engineering and equipment of the Commonwealth Edison Company that but little space will be devoted to description of apparatus in the present summary. The accompanying illustrations tell their own story. An effort is made here to present a conception of the whole enterprise in the mass, so to speak, and to treat briefly of some of the departments of the work, including the diversified uses to which some of the energy sold is put. What follows immediately is somewhat like a directory.

General Features

Offices.—The administrative center of the Commonwealth Edison Company is in the Edison Building, 120 West Adams Street, Chicago. This building stands on the site of the original generating station of the old Chicago Edison Company. In addition to offices it contains three large storage batteries, constituting a portion of the reserve for the downtown business district. It was outgrown as office headquarters years ago, and the company rents space in adjoining buildings on the east and west. In addition the company has a larger office building at 28 North Market Street, where about 60 per cent of the office help is housed. Here the engineers have three floors and there is an interesting testing laboratory. In a year or so the scattered offices of the company will be concentrated in what is now the Commercial National Bank Building, at the northeast corner of South Clark Street and West Adams Street. This building has been purchased on behalf of the Commonwealth Edison Company. It is a half block east of the present headquarters and is a large, modern eighteen-story office building, erected at a cost of $3,800,000.

Personnel.—The names of some of the officers and heads of departments are as follows: President, Mr. Samuel Insull; second vice-president, Mr. Louis A. Ferguson; assistant to president, Mr. John F. Gilchrist; secretary and treasurer, Mr. W. A. Fox; auditor, Mr. John H. Gulick; assistant to second vice-president, Mr. P. Junkersfeld; general contract agent, Mr. E. W. Lloyd; chief operating engineer, Mr. W. L. Abbott; electrical engineer, Mr. R. F. Schuchardt; engineer of distribution, Mr. H. B. Gear;

FIG. 3—EDISON BUILDING, 120 WEST ADAMS STREET, CHICAGO

superintendent of construction, Mr. J. H. Goehst; statistician, Mr. E. J. Fowler.

Stockholders and Employees.—The company has about 1700 stockholders and about 3600 employees. About 300 stockholders are employees.

Financial and Statistical.—On Dec. 31, 1912, the capital stock issued amounted to $37,764,140 and the bonds out-

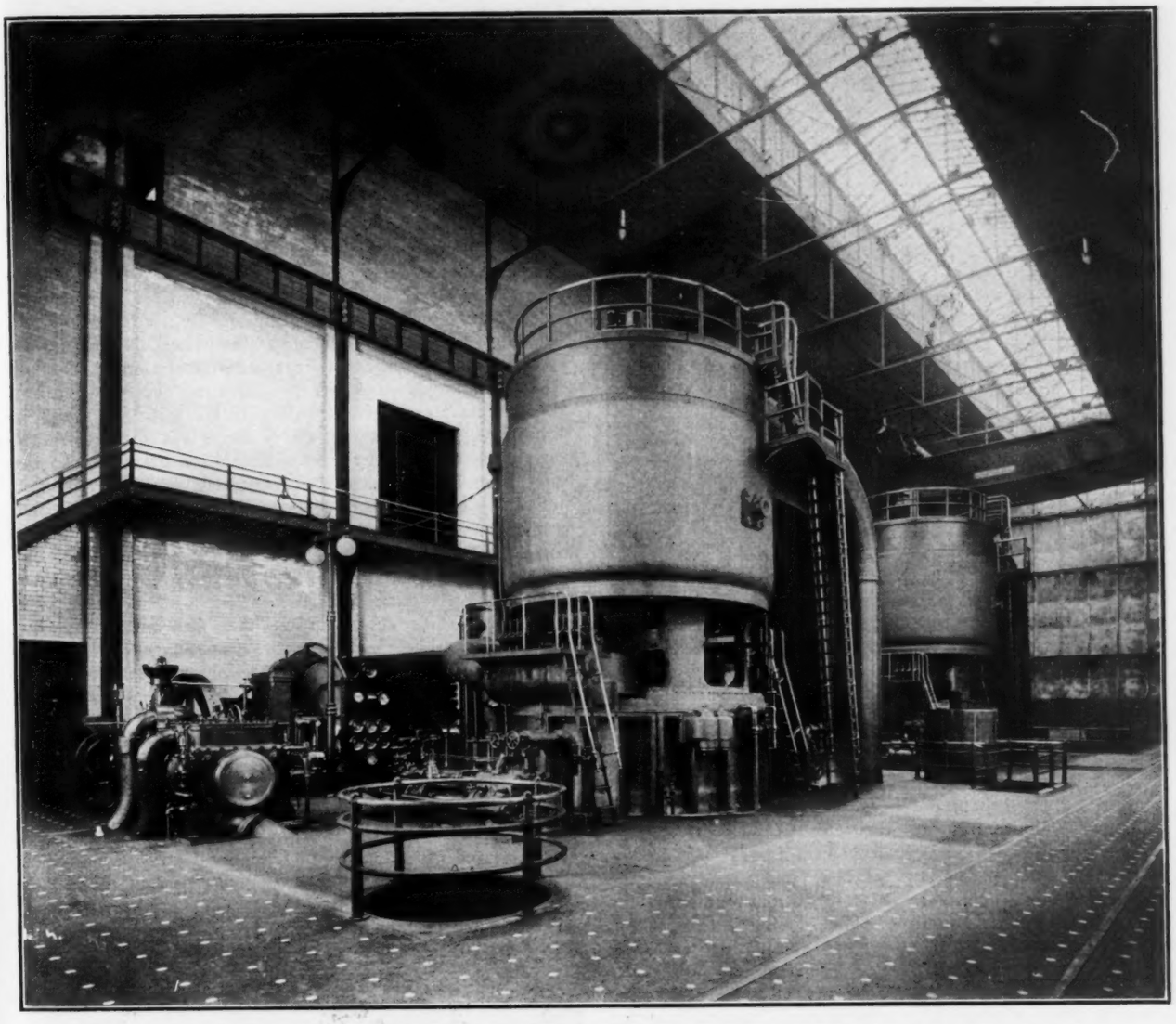


FIG. 4—TURBO-GENERATOR ROOM IN NORTHWEST STATION, CHICAGO, SHOWING TWO 20-000-KW UNITS

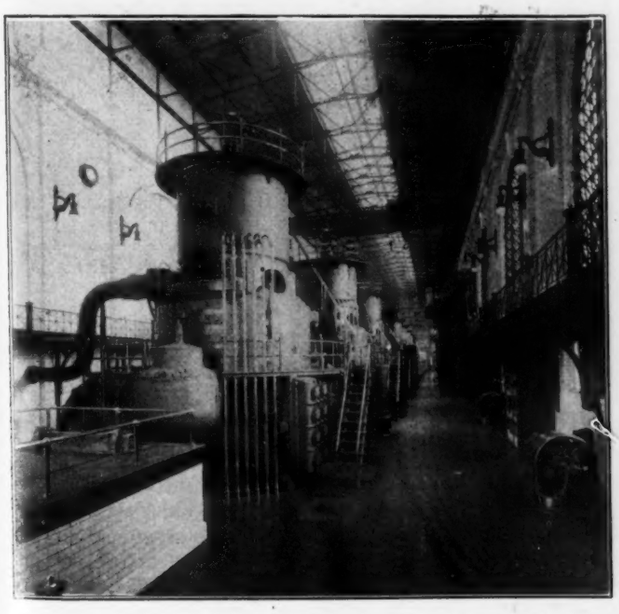


FIG. 5—TURBO-GENERATOR ROOM IN THE FISK STREET STATION

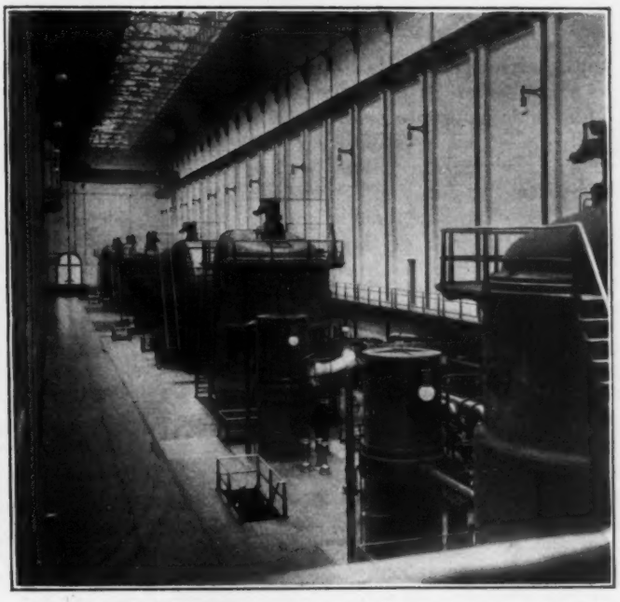


FIG. 6—TURBO-GENERATOR ROOM IN QUARRY STREET STATION

standing to $32,000,000. Seven per cent is paid on the stock and 5 per cent on the bonds. The total operating revenue in 1912 was $15,361,649; net revenue, $6,506,077. From this $1,127,194 was paid in taxes and municipal compensation. After paying bond interest and dividends and making allowance for depreciation, $921,445 was carried to surplus, which then stood at $5,252,146. On the date mentioned the company had $3,965,576 in cash. An analysis of the earnings from the sale of electricity showed 47 per cent from retail light, 24 per cent from railway load, 17 per cent from retail power and 12 per cent from wholesale light and power. The output for the year 1912 was 799,000,000 kw-hr. and the maximum load (on Dec. 11) 233,000 kw. The connected load on Dec. 31 last (exclusive of energy supplied to other public-service corporations) amounted to 8,293,523 16-cp equivalents. The company has about 185,000 customers of all sorts. Its annual load-factor is about 43 per cent.

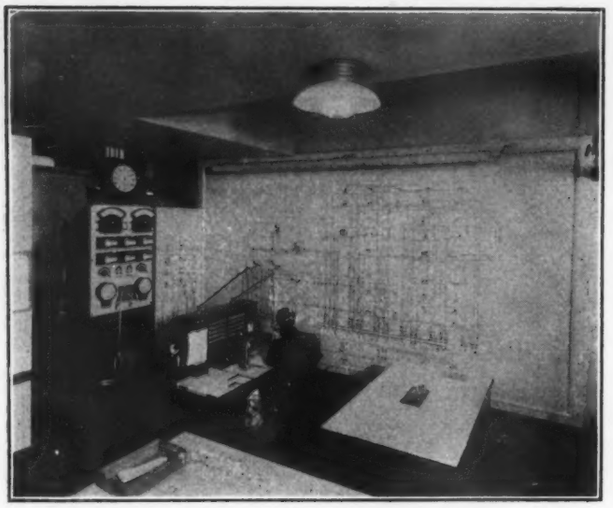


FIG. 7—LOAD DISPATCHER'S OFFICE AT HEADQUARTERS

Generating Stations.—The company has five generating stations, three of which are modern steam-turbine stations. All turbo-generators now in service are of the vertical type, but the units under construction or contemplated are of the horizontal type. The best known station is the historic Fisk Street plant, at West Twenty-second and Fisk Streets, where the first 5000-kw Curtis vertical steam turbine in the world was put in operation in 1903. That machine has since been superseded and has been set up in Schenectady as a monument. This station has ten 12,000-kw units. An addition is in progress by which the rating of the station will be doubled eventually. In the newer part which is under construction there will be erected a 25,000-kw horizontal Parsons turbo-generator, built at Newcastle, England, and a 20,000-kw horizontal General Electric turbo-generator. Across the South Branch of the Chicago River from "Fisk Street" is the Quarry Street station with six 14,000-kw units. This was first placed in service in 1908. These two plants are entirely distinct, but are operated together. The latest station is the Northwest station, on the North Branch of the Chicago River, at Roscoe Street and California Avenue, put into operation in 1912. Here there are two 20,000-kw units in service, with room for great extension. A 30,000-kw horizontal unit, which will be, no doubt, the largest in the world, has very recently been ordered for this station. The coal-handling apparatus (including an elevated electric railway), oil-switch construction and recreation grounds at this station are of special interest. The total generator rating of the system at the present time is about 260,000 kw, exclusive of storage batteries. In 1912 the company burned 1,100,000 tons of coal. Harrison Street direct-current station, dating from 1892, is used mainly as a substation.

Transmission.—Energy is transmitted from generating stations at 9000 volts and 25 cycles, 12,000 volts and 60 cycles, and 20,000 volts and 25 cycles. There are about 135 direct transmission lines and 35 tie lines. By far the greatest portion of the output is transmitted over the 9000-volt, 25-cycle system. Several tunnels under the Chicago River were built as a part of the transmission system.

Load Dispatching.—The direct control of the operation of the system centers in the load dispatcher's office at 120 West Adams Street. A private telephone system connects this office with all stations and substations. Diagrammatic boards show every generator, line and switch in the system, and plugs are used to indicate oil switches open or closed.

Substations.—There are forty-one substations. At least two transmission lines are provided for each substation. The new Court Place substation in the City Hall Square Building, on Clark Street, where there is a 3500-kw rotary converter; the Market Street substation at 22 North Market Street, where there are three different types of rotaries, and the Whipple Street substation, at 3435 Whipple Street, near the Northwest station, are interesting examples of Edison light and power substations. As Edison railway substations those at 1920 South Harding Avenue and at 4650 Lincoln Avenue may be mentioned. Those interested in "straight railway" substations may find one of the Chicago City Railway Company at 2020 South State Street and one of the Chicago Railways Company near the corner of North LaSalle Street and West Illinois Street. A typical railway substation is at 321 South Franklin Street.

Distribution.—Direct current is distributed to customers in the central portion of Chicago and three-phase, 60-cycle alternating current in all the remaining portion, which is more extensive. In the direct-current district thirteen of the twenty-two rotary-converter substations have auxiliary batteries, and there are three exclusively battery substations. There is an intricate network of direct-current mains. In the alternating-current district energy at 2000-4000 volts is supplied from the substations to line transformers installed where required.

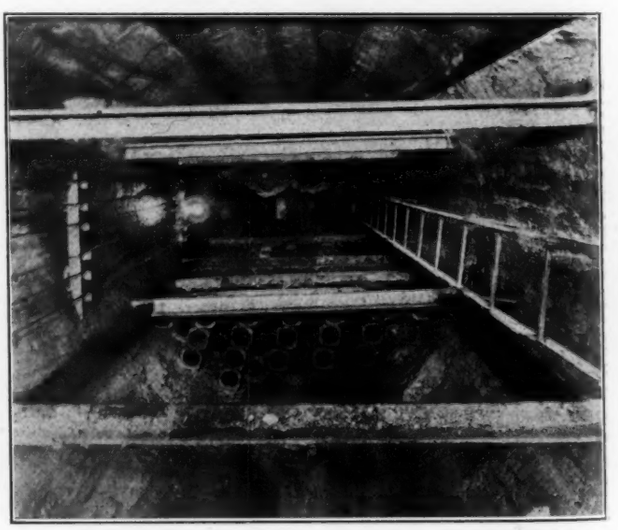


FIG. 8—SHAFT TO WASHINGTON STREET TUNNEL

Display Rooms.—Perhaps the most beautiful electric exhibition and sales establishment in the country is that of the Electric Shop, on the northwest corner of Michigan and Jackson Boulevards. Here there are several rooms fitted up with electrical conveniences and luxuries. Ladies may do their electrical shopping here just as they may select wearing apparel, jewels or furniture at other shops.

Another salesroom is maintained on the rear of the second floor of the Edison Building, at 120 West Adams Street, and electrical supplies of any nature may also be obtained at the Logan Square branch office at 2537 Kedzie Boulevard and the South Chicago branch office at 9163 South Chicago Avenue.

WELFARE WORK

In many ways the company looks after the welfare of its employees. The employees' saving fund has been in operation for about four years. During a subscription period of five years the subscriber pays in an amount equal to 3 or 5 per cent of his salary. At the end of that period he receives back all the money he has paid in with interest compounded semi-annually at the rate of 6 per cent. However, if he prefers, instead of this cash payment he may take as much of the company's capital stock as the amount of his cash payment and accumulations will then purchase at par if the selling price is then at or above par, or at the average market price during the two preceding calendar months if the selling price of the stock is below par.

A service annuity system has been established with a view of making some provision for faithful employees who have completed a certain term of service. The plan provides for retirement at the age of fifty-five, sixty or sixty-five years under varying conditions, with an annuity in general consisting of 2 per cent of the average annual pay of the employee during the particular consecutive five years when his average pay was the highest, multiplied by the number of years of service, provided that in no case shall the service annuity be less than $240 a year.

Another plan for recognition of faithful and competent service is provided by a merit system, in which merits and demerits are marked according to a carefully worked-out system. In the performance of duty ratings are based on receptiveness, application, courtesy, loyalty, accuracy, speed and reliability. The merit system applies to all employees receiving less than $2,000 a year.

The company maintains a library of 2600 volumes and about 100 periodicals, which is at the disposal of employees. The librarian issues a weekly digest of articles appearing in technical journals.

Rewards are paid for suggestions of value to the company. Prizes of $50, $40, $30 and $20 are awarded every six months, with single prizes of $10, for the ones sending in the greatest number of accepted suggestions and a reward of $1 for every suggestion accepted. The suggestions are expected to tend toward the reduction of expenditures without lowering the standard of service or affecting the amount of new business to be secured, and the improvement of the service without unwarrantably increasing expenditures in the securing of new business.

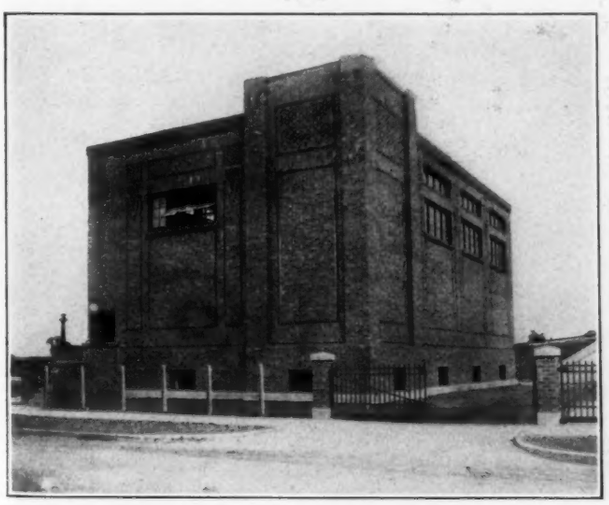


FIG. 9—WHIPPLE STREET SUBSTATION

The company assists in many ways the Commonwealth Edison Company Section of the National Electric Light Association. This section has about 1700 members and the company is generous in providing facilities for improvement and entertainment. The *Edison Round Table* is a clever monthly magazine which is published by the company section and is supported by the company. The company also sends a number of delegates each year to the annual convention of the association.

FIG. 10—MARKET STREET SUBSTATION

Recently the practice has been adopted of giving to each employee who has been in the service of the company five years or longer an appropriate service badge in the form of a gold pin which may be worn as a badge of distinction. Additional five-year periods of service are indicated by means of blue enameled stars and jewels. For instance, Mr. J. Henry Goehst, who has been with the company or its predecessors since 1882 and has the record for longest continuous service, received a badge decorated with one ruby and three blue stars.

It is the policy of the company as far as possible to assist the employees by contributing to their health and enjoyment. Rest rooms are provided for women and outings are given for men and women. The company maintains a number of tennis courts and also provides other facilities for sports, such as baseball, bowling, etc.

STATISTICAL DEPARTMENT

One of the most useful departments in the organization of the Commonwealth Edison Company, but one about which little is heard, is the statistical department. The statistician of the company has from forty-five to fifty men under him. He keeps all manner of statistical records. In preparing statistical statements relating to customers the Hollerith perforated-card system is employed and is found very useful. In this department data relating to output, load curves, unit costs, unit income and many other things are collected and calculated. There is a work-order division which issues work orders and keeps track in a general way of the cost.

STREET LIGHTING

The general street lighting of Chicago is supplied mainly by arc lamps and series-tungsten lamps operated by the Sanitary District of Chicago under a contract arrangement with the city. Examples of the new flame-arc lighting may be seen at East Forty-third Street and Cottage Grove Avenue and of the new series-tungsten lighting at East Forty-third Street and Lake Avenue. The Commonwealth Edi-

son Company does a large amount of business in supplying and maintaining systems of private street lighting under contract with business men in various localities. The company furnishes and installs curb-lighting systems in compliance with the standards prescribed by the city. Usually there are clusters of four or five 60-watt tungsten lamps on an iron post, although in some installations single 250-watt lamps are used. For this service flat rates ranging from $1.75 to $2.37 per week per post are charged, the variation being due to the type of post used and to the hours of consumption. On April 1 last the company maintained 2571 private street lamp-posts.

ELECTRIC LIGHT COST CUT ½ IN 10 YEARS
HOUSE WIRING & FIXTURES
ARRANGED FOR IN 24 MONTHLY PAYMENTS
Commonwealth Edison Company

FIG. 11—SIGN ON HARRISON STREET STATION

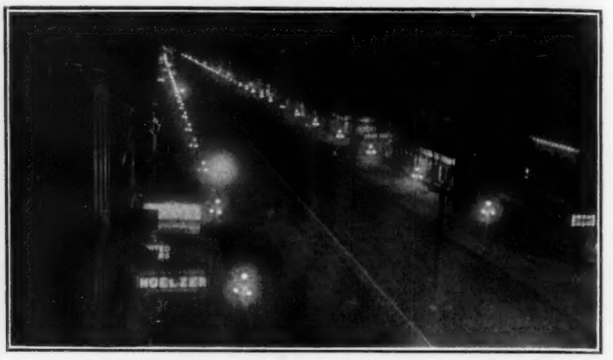


FIG. 13—PRIVATE STREET LIGHTING IN NORTH AVENUE

The beautiful boulevard lighting on Michigan Boulevard from Lake Street to Twelfth Street, and recently extended on Jackson Boulevard, was installed by the South Park commissioners, energy being obtained from the Sanitary District. The new flame-arc lighting on Dearborn Street, utilizing street-railway posts, is the result of an arrangement made by a property owners' association with the city and the Sanitary District. An interesting example of park lighting is that in Lincoln Park and on North Side boulevards where small arc lamps are placed in opal balls mounted on graceful concrete lamp-posts. One of the most interesting street-lighting installations in Chicago consists of the six quartz-tube lamps suspended by steel booms from buildings on West Randolph Street between North LaSalle Street and North Fifth Avenue. These powerful lamps are operated on 220-volt Edison circuits, each taking 726 watts, and are rated at 4800 cp each in the direction of the lamp's maximum efficiency as installed. They were installed in August, 1912, and have received no attention since except for cleaning.

FIG. 12—ROOF SIGN ADVERTISING ELECTRIC SERVICE

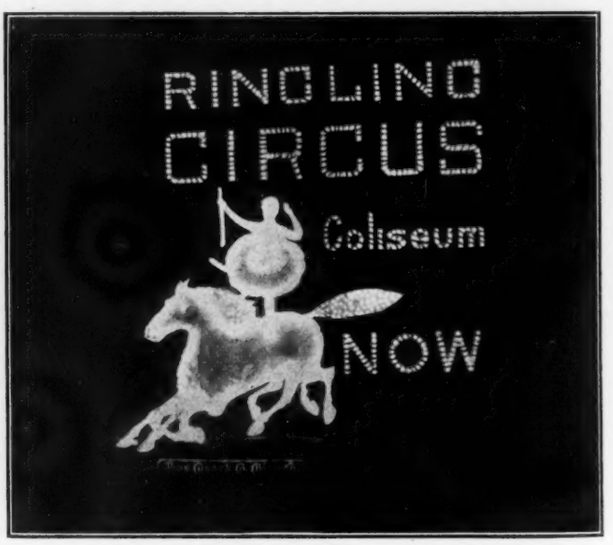


FIG. 14—ELECTRIC DISPLAY SIGN

Electric Signs

Chicago has a number of spectacular electric roof signs, but progress in this direction has not been particularly noteworthy. However, the number of electric signs on buildings or projecting over sidewalks is very large. The city ordinance allows electric signs to project from buildings as far as the curb line, but the Mayor has absolute authority in the matter of revoking electric-sign permits.

Not only is the company an advocate and an extensive advertiser of the advantages of electric vehicles, but it is itself one of the largest users of such vehicles in Chicago. Its fleet consists at present of seventy-one cars—trucks, delivery wagons and passenger vehicles—and these are used for all the varied purposes of the company. Edison men co-operate actively with the Chicago Section of the Electric Vehicle Association and with manufacturers, dealers and garage operators. The main garage of the company is at 211-213 Morgan Street. As typical modern commercial electric vehicle garages the Terminal Garage, at 4464 Evanston Avenue, and the Fashion Garage, at Fifty-first Street and Cottage Grove Avenue, are worthy of mention.

The large contract department of the company devotes itself not only to getting new business but to retaining old customers and co-operating and advising with them in relation to their electrical needs. The work is carefully systematized under the supervision of the general contract agent. The assistant to the general contract agent, the

engineer of the department, the special agent and the power engineer have charge of the various branches of the work. The department has specialists who advise owners of electric vehicles, storage batteries, factory installations and lighting equipments as to the economical uses of electrical energy, taking the customer's viewpoint. The department has several notable campaigns to its credit in introducing electric flatirons and other devices. Meetings are held monthly, at which the agents discuss various problems connected with the merchandising of electrical energy.

Under the terms of the contract with the city of Chicago which went into effect in 1908, and under which the company is still operating, the company agreed that its rates for electricity for lighting should be gradually reduced until the net primary rate should not be more than 12 cents, and the net secondary rate not more than 6 cents, a kw-hr. However, the company has established the policy of making voluntary reductions when found practicable, and by a series of such reductions it was able to bring its net primary rate to 10 cents a kw-hr. on April 1, 1912, and its net secondary rate to 5 cents on Oct. 1 of the same year. These are the present maximum rates and may be styled the general lighting rates. They include free lamp renewals of standard carbon-filament lamps. In addition to these regular rates, but in no case in excess of them, there are schedules of rates for lighting, including flat rates for constant-potential arc lamps, flame-arc lamps, tungsten fixture lighting, sign lighting, private street lighting and series-arc lamps. The rates for motor service are measured rates exclusively. They begin at the regular rates and are lowered by quantity discounts. There are also wholesale rates for electricity supplied in large quantities under varying conditions ranging as low as 0.7 cent per kw-hr. for the secondary rate, or lower for the secondary rate under certain stipulations. Another schedule of rates relates to throw-over switch service where the consumer desires to be in position to use the company's service during the temporary break-down or cessation of his own plant. In this case the consumer is required to pay a minimum monthly charge based on the lamps or motors in service, regardless of the actual consumption of electricity.

Twelve years ago the Chicago Edison Company, predecessor of the Commonwealth Edison Company, made its first contract to supply electrical energy to a railway company at wholesale, the first customer being what is now the Chicago & Oak Park Elevated Railroad Company. This service has been demonstrated to be based on principles economically sound, and at the present time 70 per cent of the energy requirements of all the elevated and surface railways of Chicago is supplied by the central-station company. By utilizing the diversity-factor the electric-service company is enabled to make to these large consumers rates which, while very low, are satisfactory to the producer.

The committee on gas, oil and electric light of the City Council of Chicago has now under consideration the possibility of revising the maximum rates of the company at the end of the five-year period provided for in the contract ordinance with the city. However, as mentioned above, the

FIG. 15—INTERIOR OF ELECTRIC SHOP, CHICAGO

company has made voluntary reductions so that it may be found that further reductions are not justified. It is of interest to note that the company has 12,000 customers whose monthly bills in 1912 averaged $1 or less.

Work of the Advertising Department

One of the characteristics of the company for many years has been the liberal use it has made of printer's ink. Large appropriations for advertising were made early in Mr. Insull's administration when such a procedure was much less common than it is now. This policy has been followed consistently, with very good results, it is believed. New business is obtained largely by personal solicitation, but this is backed up by a continuous campaign of publicity. This publicity consists not only in newspaper advertising but also in booklets, circulars and a large amount of other printed matter which is issued from time to time. In addition the company advertises by means of electric signs, moving-picture films, signboards and various demonstrations and exhibits. Each month's lighting bills have a short announcement or advertisement.

FIG. 16—MAGAZINE AND ADVERTISING LITERATURE

The advertising and publication department has its headquarters in the building at 28 North Market Street, where an entire floor is devoted to it. The department is in charge of Mr. D. H. Howard, who has been at its head for the last twelve years and has brought it to its present high standard. The advertising committee of the company consists of Messrs. Gilchrist, Lloyd and Howard. It meets weekly with the representative of the agency placing the newspaper advertising and determines the nature of copy to be inserted in the newspapers the following week. The advertising copy is carefully prepared and is fresh, original and timely.

The company publishes a monthly magazine, *The Electric City*, now in its tenth year, and this is used as an educational feature for distribution among customers. These magazines are distributed through the drug stores in Chicago without charge, and there is also a large mailing list. The *Edison Round Table*, the official publication of the Commonwealth Edison Section of the National Electric Light Association, is also issued from this department. The activities and resources of the advertising department are extensive and varied. For instance, it has recently issued a large mail-order catalog in connection with the business of the Electric Shop. Another attractive booklet of recent date is entitled "Electricity in the Home."

At White City, at Sixty-third Street and South Park Avenue, one of the largest amusement parks in the city, the company leases a building for the purpose of exhibiting and demonstrating various electrical appliances, particularly such as are used in the household. The main portion of this building is equipped as a moving picture theater, wherein the company shows a number of comedy films illustrating in a practical way the convenience and desirability of cooking by electricity.

Some of the Users of the Product

In a city like Chicago the most diversified uses are made of the electrical energy sold by the central-station company. Department stores, office buildings, hotels, newspapers, theaters, garages, clubs, hospitals, grain elevators, foundries, ice plants, steel and iron fabricators, printing establishments, woodworking shops and miscellaneous factories are large users.

Nearly all of the large State Street department stores are customers of the Commonwealth Edison Company, Marshall Field & Company alone having a connected load of 1200 kw for lighting and nearly 5000 hp for motors.

ECONOMY
CLEANLINESS
CONVENIENCE
SAFETY
Electric Light in the home is one of humanity's greatest benefits—a comfort you owe yourself and your family, if you do not already enjoy it.
Commonwealth Edison Company
It is easy to rent houses wired for Electric Light
The "For Rent" sign comes down when Electric Light is installed
Commonwealth Edison Company
Does Your Power Increase As Your Business Grows?
Commonwealth Edison Service
Commonwealth Edison Company
Mr. Store Owner—
You Can Have the Services of Our Illuminating Engineering Department Absolutely Free
Get More Effective Lighting at Present Cost—or Less
Commonwealth Edison Company

FIG. 17—SAMPLES OF NEWSPAPER ADVERTISING

The list of office buildings on the company's circuits would be a long one if given. It includes the Railway Exchange Building with 530 kw in lamps, the Insurance Exchange, the Monadnock, Marquette, City Hall Square, Bell

Telephone, Harvester, Republic, Merchants' Loan & Trust and many other buildings.

Among hotels may be mentioned the Hotel Sherman, Palmer House, Metropole, Plaza, Briggs House and a number of others.

In the metal trades are some of the largest consumers. The Crane Company, manufacturers of pipes, valves and fittings, requires no less than 7000 hp in motors; the L. Wolff Manufacturing Company, plumbers' supplies, takes about 1500 hp; Joseph T. Ryerson & Son, 1500 hp; Ajax Forge Company, 1200 hp; Union Drop Forge Company, 550 hp; Vierling Steel Works, 500, and so on. Among other consumers of this class are Foote Brothers' Gear & Machine Company, Griffin Wheel Company and the Seng Company (furniture hardware).

Ice-making plants constitute a desirable class of customers. The Consumers' Company takes 640 hp for its Lexington Avenue plant alone, and the Lincoln Ice Company requires 507 hp. There are a number of others.

FIG. 18—CLOTH CUTTING BY ELECTRICITY IN SHIRT-WAIST FACTORY

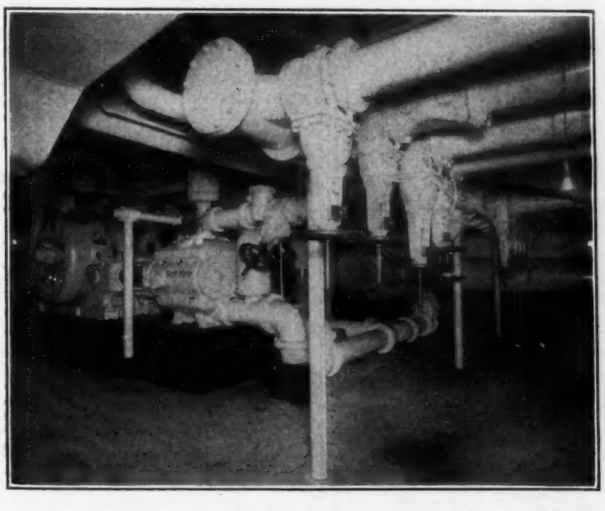


FIG. 19—PUMPS IN BASEMENT OF MARSHALL FIELD STORE

Among newspapers operating by central-station energy are the *Tribune, Examiner, Journal, American* and *Evening Post*. The *Tribune* establishment requires 1200 hp in motors alone.

Some of the largest printing and publishing establishments in Chicago are electrically operated by central-station energy, including Poole Brothers, R. R. Donnelly & Sons Company, W. F. Hall Printing Company, A. C. McClurg & Company, Kenfield-Leach Company, and many others.

Theatergoers view the stage pictures in many of the houses by electric light supplied by the Edison company. The Grand, McVicker's, Princess, Powers, Illinois and Colonial theaters are customers of the company, among others.

A large number of woodworking establishments are supplied with central-station energy. The H. P. Nelson Piano Company takes 530 hp, the J. W. Landis Mill Company 250 hp, and Joseph F. Sturdy 109 hp. Among other customers of this general description are E. T. Filer, the Hafner Furniture Company, W. W. Kimball and A. G. Spalding & Brothers Manufacturing Company (baseball bats).

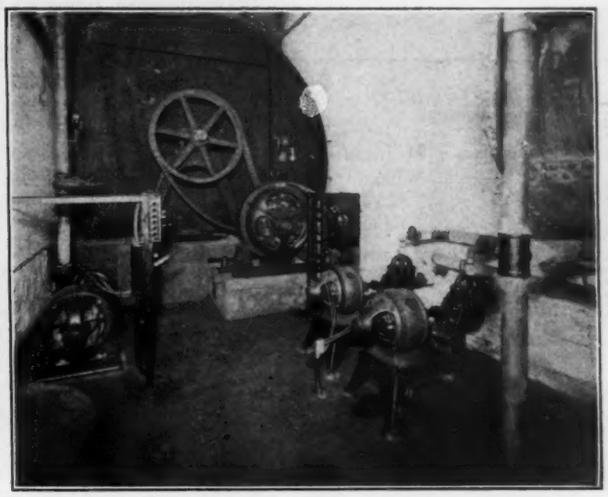


FIG. 20—VENTILATING AND PUMPING EQUIPMENT IN MEDINAH TEMPLE

With the increasing use of the electric-vehicle public garages become correspondingly important as users of electricity. The Fashion, Terminal, Elite and Bland garages have connected loads rating from 100 hp to 185 hp.

The Mueller & Young Grain Company has a connected load of 750 hp in its grain elevator, and the Pennsylvania elevators, J. Rosenbaum Grain Company and W. G. Burns are other grain-elevator customers.

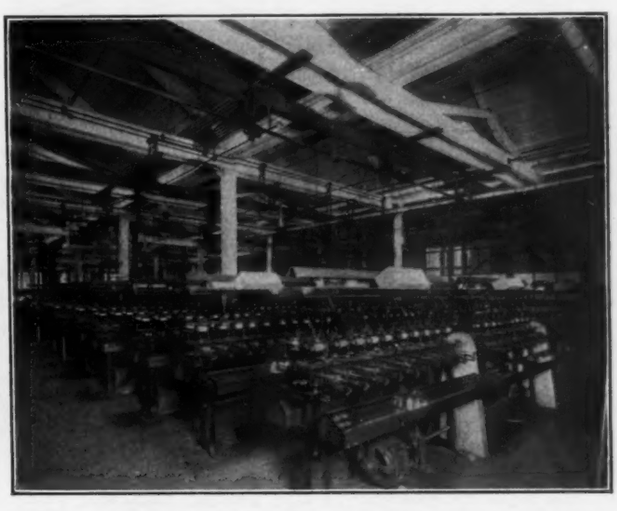


FIG. 21—VIEW IN ELECTRICALLY DRIVEN SILK FACTORY

A large number of miscellaneous industries are connected with the company's circuits. Among these are engraving plants like that of the Federal Engraving & Colortype Company, silk manufacturers like the Oscar Heineman Company, and Hugo DuBrock & Company, maker of shirtwaists.

Unified Public Utilities in Central Illinois

Interconnected system for supplying 125 communities from 700 miles of 33,000-volt transmission lines—Value of diversity factor

FAR-REACHING plans to replace ninety local generating plants by a handful of modern central stations and 700 miles of transmission lines are being carried out by the Central Illinois Public Service Company, which is preparing to serve the electrical and utility needs of a population of a quarter of a million in forty counties and more than 125 communities of the central, western and southern parts of the State, in addition to extensive and diversified power applications in the operation of coal mines, drainage plants, electric railways, water-works, ice factories, etc., scattered over the 350-mile radius of the company's activities.

The Company's Rich Territory

The territory reached by the lines of this public-service corporation includes some of the richest counties in the central and southern sections of Illinois. Within a radius of 25 miles of two of its future central stations are practically all the mines of the two great coal fields of the State. In the broad valley of the Illinois River lie 250,000 fertile but submerged acres only waiting to be reclaimed as rich farm land by electric drainage pumping. Farm applications of electricity present another great prospective industrial load for the secondary ramifications of the company's system, which is sure to develop as fast as the practical uses of electrical energy in agriculture are brought to the realization of rural communities. And with progressive towns and cities demanding their quota of electricity for motors and lamps, rapid electric railways driven from the same buses linking these centers of population, electric operation of water-works and ice factories, etc., the possibilities of such a unified rural system mount to a magnitude comparing well with some of the largest urban undertakings.

Viewed in the light of a human benefaction, such syndicate operation has made available in small, remote communities electric service at any hour of the day or night which would otherwise be either altogether out of the question or feasible only at a rate far in excess of that which transmission makes possible.

But perhaps the most interesting aspect of the Central Illinois situation is the diversity of demand with which the various loads occur, making possible high system load-factors and great operating economies. The coal miners of this district, for example, insist on quitting work at 4 p. m., and after that hour the great electrical installations in the mine plants are largely standing idle, thus leaving corresponding station capacity available for the town lighting loads which come on a little later.

Again, electrical energy for drainage pumping of the river bottoms is required chiefly during the spring months, a time when the coal mines are running at their minimum output if at all, so that here again there is a distinct annual diversity between these great power loads. By extending its policy of operating electrically driven raw-water ice factories in local communities where a market is offered for the frozen product the company further assures itself a source of summer load and income, to offset the seasonal decrease in kilowatt-hour production. Town water pumping is another long-hour application which has a distinct season load-factor in addition to the flexibility with which, by pumping into a standpipe, the load can be kept clear of the evening lighting peaks.

District-Heating Service

Even the district-heating service of the company contributes to this remarkable diversity of operation which, like Emerson's principle of compensation applied to human affairs, seems to be a veritable law of the central-station industry. In taking over the numerous small steam plants acquired during consolidation it has been the plan to continue in operation during the winter months those stations which furnish local heating service through the medium of either exhaust steam or hot water. A utility service is thus preserved which is both valuable to the community and profitable for the company, in addition to which the company makes available during its heavy winter demand the electrical generating capacity of these combination heating plants, securing their kilowatt-hour output at very low net expense. During the warm months these non-condensing heating plants are shut down, the local electrical service being furnished over transmission lines from the company's central and highly efficient turbine condensing stations.

The Central Illinois Public Service Company is a subsidiary of the Middle West Utilities Company and in the

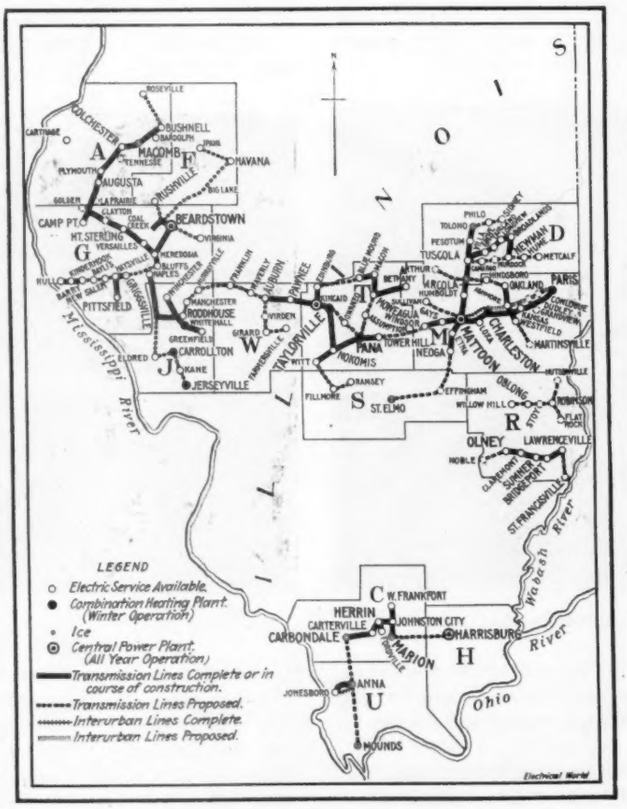


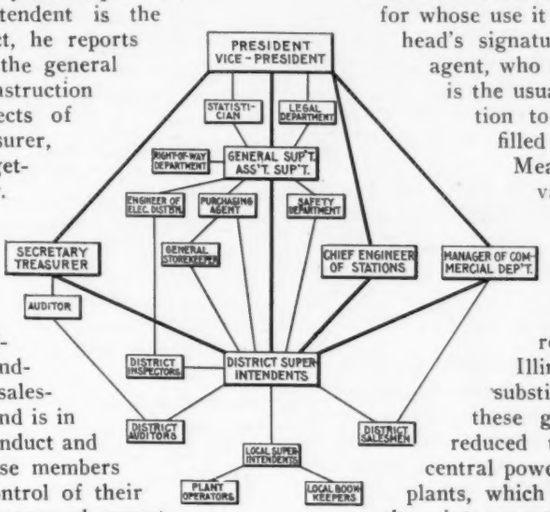
FIG. I—CENTRAL ILLINOIS COMPANY SYSTEM

section of the State named supplies service in communities scattered over an extreme range of 350 miles. The general offices of the company are at Mattoon, Ill.

DIVISIONAL PLAN OF COMPANY ORGANIZATION

The great territorial distances encompassed in the company's operations have made necessary a plan of operating organization of its 1200 employees somewhat similar to the divisional scheme used in railway management. For convenience the territory reached by the lines is divided into districts, as shown on the accompanying map. These districts are designated by letter, usually the initial of the principal town, and each is in charge of a district superintendent who as a single individual represents and reports to the several engineering, operating, accounting and commercial departments at the company's headquarters.

Although the district superintendent is the executive authority in his district, he reports on matters of local operation to the general superintendent at Mattoon, on construction to the chief engineer, on subjects of accounting to the secretary-treasurer, and on matters of new-business getting to the commercial manager. Detailed as his assistants and reporting to him, but under the control of their own department heads, the district superintendent has the help of his operating staff of plant engineers and local town superintendents, accountants and commercial salesmen. He directs their activities and is in general held responsible for the conduct and operation of his district, but these members of the staff remain under the control of their own departments and cannot be removed except by their own chiefs. In staff adjustments, of course, the recommendations of the district superintendents are carefully considered.



It is the aim to have the local superintendents identify themselves with their communities by displaying active interest in local affairs, at the same time receiving from the public recognition as the company's representatives in the fullest sense. While thus instilling confidence in the individual and stimulating him to his best efforts, this scheme of organization makes for the greatest unity in the local staff. Full co-operation between the local operating, accounting and commercial departments is assured because all three are represented in the single person of the district superintendent. On the other hand, the invaluable element of specialized knowledge and division of labor is supplied by detailing departmental experts to work under the supervision of the local executive.

With such a form of organization there is little likelihood of the varying attitudes too frequently assumed toward the customer by the sales, accounting and operating staffs respectively under "absentee-syndicate" operation. Instead, the local manager fully realizes that the customer must not only be treated well at the outset but must receive good service and courtesy from all departments as long as his patronage is to continue. There can then be no quarrels between the various local departments unless the district superintendent chooses to take himself to task, for the entire responsiblity of the operation of the district is placed in his hands.

As shown by the accompanying diagram, the various main-office functions of auditor, electrical distribution engineer, right-of-way man, purchasing agent, storekeeper, maintenance-of-way department, safety inspector, etc., are placed under the supervision of the secretary-treasurer, the general superintendent and the commercial manager, who, with the chief engineer, the statistician and the legal department, report to the president and vice-president. These officers in turn confer with the officials of the holding and associated companies with which the Central Illinois Public Service Company is closely related.

The principle of unified management of electric properties affords economies in many other respects besides its savings in operating costs. In maintenance outlays, for instance, the advantages of making purchases through an experienced centralized purchasing department result in substantial savings owing to quantity buying and close attention to prices.

Requisitions for supplies usually originate with the local superintendent, who transmits a memorandum of what is needed to his district superintendent. This official in turn approves and forwards the requisition to the Mattoon office, where it is referred to the chief of the department for whose use it is needed. With the department head's signature it is sent to the purchasing agent, who asks for bids. About seven days is the usual interval required for a requisition to traverse this route until it is filled in the purchasing department. Meanwhile it is scrutinized by the various authorities qualified to pass on the justification of the expenditure.

Ninety local steam plants formerly furnished electrical service in the territory now reached by the lines of the Central Illinois Public Service Company. By substituting substations the number of these generating plants has now been reduced to about twelve, including the central power houses and the district-heating plants, which latter are operated only during the winter months to furnish local steam or hot-water heating service. At other times of the year these local non-condensing plants will be shut down, electrical energy being supplied to the system by the modern turbine condensing stations now in course of construction.

Among the individual properties as acquired by the Central Illinois company there was little or no uniformity in the character of service furnished. Some supplied direct current, and others offered a wide variety of single-phase, two-phase and three-phase alternating current at frequencies of 133, 60 and 25 cycles. This service is now, however, all being standardized to three-phase, 60-cycle alternating-current generation, with 33,000 volts as the transmission potential and 2300 volts as the local distributing pressure. Later 8000-volt circuits may be employed as branch lines from the 33,000-volt trunk transmissions.

4000-KW PIT'S-MOUTH TURBINE PLANT AT KINCAID

When the present plans are completed the generating situation of the company will consist of a modern 4000-kw turbine condensing plant located near the mouths of electrically operated coal mines at Kincaid, the reconstructed 2000-kw steam-engine plant at Mattoon, a new 5000-kw turbine station to be erected at Beardstown, and a dozen combination district-heating plants run only during the winter months.

A glance at the map will show the symmetrical positioning, along the future main transmission trunk line, of the company's three principal generating stations at Kincaid, Beardstown and Mattoon. In the case of some of the local heating plants it will also be the policy, as the nearby electrical development outstrips the equivalent demand for exhaust steam, to install condensing equipment, converting these stations to all-year operation to supply the electrical demands, then dense.

At Kincaid, Ill., virtually at the mouth of one mine, and at

almost the geometrical center of the great central Illinois coal field, there is now under construction for the company a modern 4000-kw turbine condensing station. The pit which will supply coal to this plant will be itself electrically operated with energy from the station buses. Electric coal-cutting machines will free the fuel from the carboniferous seams 400 ft. below ground, and electric hoists will raise the coal to the surface, where it will be discharged into transfer cars bound for the plant, a few thousand feet distant. While the chief fuel supply for the station will come from this mine coal may, of course, be taken from any of the large number of pits in the vicinity, several of which are being developed by interests associated with the electric company.

The initial equipment of the Kincaid station comprises one 2500-kw and one 1500-kw horizontal General Electric turbine-generator set. Steam for these units will be generated in a battery of one 500-hp and two 350-hp Babcock & Wilcox boilers. As shown by the sectional elevation of the station, coal brought in by standard-gage cars will be discharged into the 102-ft. x 25-ft. concrete storage pit, 16 ft. deep, or transferred by crane to the hoppers feeding to the automatic stokers. Ashes will be removed by narrow-gage cars on the basement level. The 10-ft. smoke breeching is carried on the roof outside the boiler room, contributing to the low temperature and comfort of this compartment. A 13-ft. concrete stack, 200 ft. high, will carry aloft the products of combustion.

Auxiliary and Electrical Equipment

Of the auxiliaries for the turbine equipment, the dry-vacuum pumps will be steam-turbine reciprocating machines, while the circulating pumps are to be of the motor-operated centrifugal type. The selection of surface condensers in this station will permit the re-use of the feed water, over and over again, contributing to improved boiler performance. The condenser for the 2500-kw unit has 7200 sq. ft. of surface; that for the 1500-kw set, 3200 sq. ft. Both are located at the basement level. A pair of 30-in. pipe lines provide for the condenser circulating supply and discharge.

Adjoining the 90-ft. by 56-ft. turbine room, and forming a part thereof, is the 24-ft. by 90-ft. switch house, which on two gallery levels contains the controlling switchboard, the 33,000-volt high-tension oil switches and lightning arresters and the line entries. In nine separate concrete cells, their floors depressed 12 ft. below the turbine-room floor, provision is made for isolating three 1000-kva banks of single-phase transformers which will step up from the generator voltage to the line potential, 33,000 volts. With the arrangement shown, the 30-ton crane which spans the turbine-room floor becomes available for handling the heavy transformers as well as the prime-mover apparatus.

Aluminum-cell lightning arresters with indoor-type horn-gaps will be installed on the second floor of the switch house. Control of the station equipment, oil switches, etc., is centered in a benchboard and group of vertical panels located at one end of the present switch house, but which will ultimately become the center of the plant as the station is enlarged. The Kincaid plant is expected to be in operation by Oct. 1 of the present year.

Reconstruction of Mattoon Station

In the plant at Mattoon a new Chuse engine driving a 500-kw Westinghouse 2300-volt, 60-cycle, three-phase alternator is now being installed, while a former 25-cycle Rice & Sargent engine set is being converted to 60-cycle operation with the addition of a General Electric alternator and a 25-ton flywheel. In the downtown district Mattoon has been supplied with direct current from a group of small machines in the station, while the residence districts have received 133-cycle lighting service.

The local plant also furnishes nearly 140,000 sq. ft. of hot-water radiation. Steam pumps circulate the water which is heated in surface condensers in the engine exhaust line. A back pressure of 5 lb. to 7 lb. per sq. in. is thus imposed during the heating season. The Mattoon plant, however, will afford an exception to the company's general policy of summer shut-down of its combination heating plants. Partly on account of the summer use of hot-water service in the town, it is the intention to run this non-condensing plant all the year round as one of the principal generating stations of the system.

A 300-kw rotary converter in the plant furnishes 600-volt energy for the local street railway and for the Mattoon-Charleston interurban line. A 500-hp automatic-stoker Babcock & Wilcox boiler has also been newly installed, supplementing the existing equipment of two 300-hp Babcock & Wilcox boilers, one 300-hp Stirling and one 425-hp Altman-Taylor boiler.

Winter Operation of Combination Heating Plants

Among the heating plants which will be continued in commission but will be shut down each year during the five months from May 31 to Oct. 1 are the 1200-kw engine and turbine plant at Taylorville, 800 kw in engines and turbines at Paris, 500 kw in engines at Charlestown, 700 kw at Macomb, 500 kw in turbines and engines at Tuscola, 500 kw in engines at Bushnell, and the engine plants at White Hall, Jerseyville and Carrollton.

In preparing these plants for interconnected operation with the rest of the system it has been necessary to replace in many cases existing station equipment with 60-cycle, three-phase alternating-current apparatus. In many cases, however, only night service was formerly given, and as the lamps which made up the chief load operate equally well, of course, on the new service, the burden of apparatus exchanges has not been heavy.

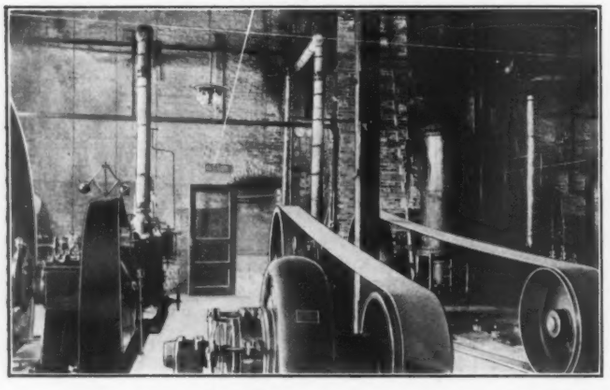


FIG. 2—INTERIOR OF TUSCOLA STATION, TYPICAL OF PLANTS REPLACED

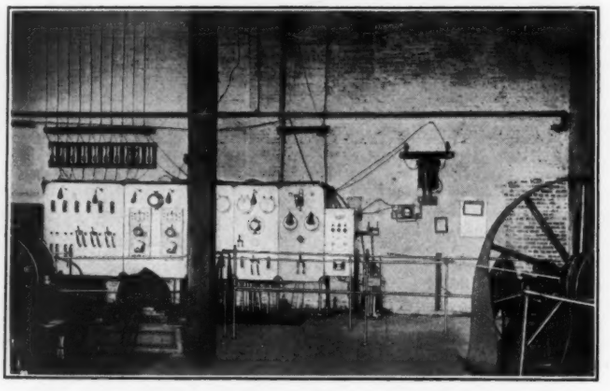


FIG. 3—SWITCHBOARD IN TUSCOLA PLANT, TYPICAL OF OLD EQUIPMENT REPLACED

33,000-VOLT TRANSMISSION SYSTEM

A high degree of excellence and permanence characterizes the transmission lines being erected to join the various plants and communities of the Central Illinois company. The transmission system is operated at 33,000 volts throughout, and of the 700 miles of lines contemplated and laid out 150 miles have already been built.

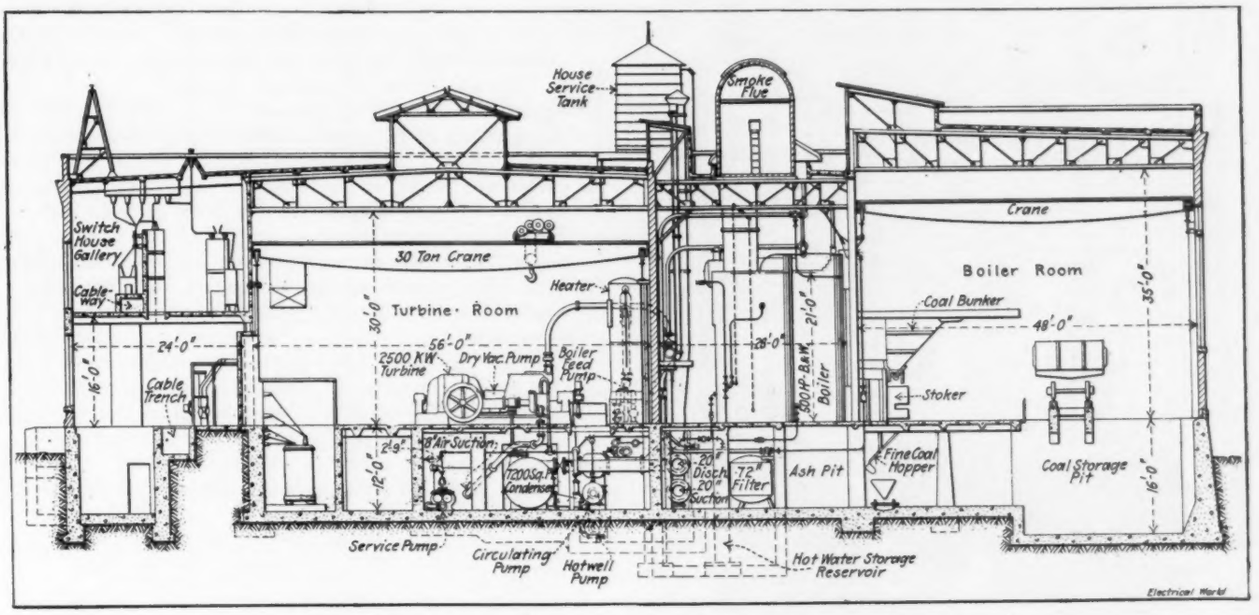


FIG. 4—SECTION THROUGH STEAM-TURBINE STATION AT KINCAID

Practically all of this mileage is of what the company denotes as its type B construction, carrying a single 33,000-volt, three-phase circuit as shown in the illustration. For the main trunk lines No. 1 or No. 0 medium hard-drawn conductor is employed, while for the branch lines No. 4 hard-drawn copper is sometimes used. Both Locke and Thomas 44,000-volt porcelain pin-type insulators are standards for this construction and are mounted on Electric Service Supplies Company No. 119 steel pins, with through-bolts seating the pin saddles on the cross-arms. The arms are of Washington fir and are put up untreated.

For cross-country construction the smallest pole used is 35 ft. in length, with 7-in. top. Such a pole is set 5 ft. 6 in. into the ground, and before raising has its roof, gains and whole butt brush-treated with two coats of Carbolineum or C-A wood preserver. On tangents these poles are set at 120-ft. intervals, shortening the spans to 80 ft., however, when approaching corners. For such turns double-pole construction is used wherever possible. All guys are broken by two porcelain strain insulators and are held by either 8-in. Bierce anchors or ordinary "deadmen." When it is not practicable to guy overhead structures the poles are cribbed in the ground, giving larger bearing surfaces to resist side strains.

Minimum distances of 3 ft. are preserved between the 33,000-volt line conductors throughout. Wires are pulled up without tension test, but are designed instead for 6-in. to 8-in. sag per 120-ft. span at winter temperatures. Running the length of each transmission circuit there is carried a 0.25-in. copper-clad steel ground wire, supported by a U-bolt on a 4-ft. bayonet of 2.5-in. by 2.5-in. by 0.25-in. angle section. This bayonet is pinned to the pole both by the cross-arm lag bolt and by a second bolt 9 in. below the first. Every fifth bayonet is grounded by a copper-clad wire run down the side of the pole beneath molding and connected to a 0.5-in. ground pipe driven 8 ft. into the earth alongside the pole butt. Line conductors are transposed at least one complete turn in 12 miles, the interval ratios being one-sixth, one-third, one-third and one-sixth respectively.

For railroad crossing the special type of construction employed is similar to the standard line design but much heavier. Wherever possible such crossings are made at right angles to the line of the tracks, the maximum span being 100 ft. For a distance of one or two full spans on each side of the crossing span, the regular line conductor is replaced by a heavier stranded copper conductor to insure against starting of breaks due to nicks in the wire surface. At such crossing spans all the steel pins are also grounded by a galvanized-iron plate which fits over the top surface of the cross-arm and is connected to the ground wire down the pole.

RIGHT-OF-WAY AND CONSTRUCTION METHODS

Whenever conditions permit, the transmission lines follow country roads or railroad rights-of-way, the poles being set 2.5 ft. back from the property line on the land adjoining the highway. This position assures that the cross-arms or wires shall not trespass over the boundary. Permission to erect and maintain the poles is usually secured from the property owner through the means of a lifetime lease, paying the owner for the privilege at the nominal rate of $1 per pole.

Where it is necessary to have trees trimmed to clear the lines the company usually hires the farmer himself to do the work, offering a liberal price. This not only assures the farmer's good will but usually results in the owner's deciding to cut down the whole trees so that, once for all, the possibility of any future line interference is entirely removed. The farmers are also hired to haul the poles, thus securing ingress to the right-of-way across adjoining property, a privilege which is not included in the permission granted by the form of pole lease. Where the poles are erected along a public road franchise rights are secured in advance from the county highway commissioners.

The work of building the pole line is carried out by three sets of workmen who follow in succession along the right-of-way. In the order in which they come, they are the gaining gang, the setting gang and the line-construction gang. Two or three men make up the gaining gangs, usually composed of cheaper labor. These men cut the gains, bore the holes for the through-bolts, and trim the poles ready for erection. Sometimes it is possible to have this work done in the pole yard, but usually the gaining gang's serv-

ices are necessary on the ground to prepare the poles for the erecting gang which follows. This latter pole-setting gang may number as many as thirty. Its duties are confined to raising and setting the timbers, fixing the necessary guys roughly and tacking the ground wires onto the sides of every fifth pole.

Lastly comes the line gang, numbering perhaps fifteen

FIG. 5—STANDARD SINGLE-CIRCUIT 33,000-VOLT TRANSMISSION LINE

and made up of skilled linemen, groundmen, helpers, teamsters, etc. They fix the cross-arms, run up the wire and finally complete the job. A pole gang can set 1.5 miles of poles per day, and one line gang has run in as much as 4 miles of wire in a record day's performance. For making splices on the Central Illinois lines both wrapped and sleeve joints are used, although the latter are regarded as preferable.

Two-Circuit Construction for Town Entries

The type A construction of the Central Illinois company provides for two circuits instead of one as in the case of the "B" type. Ten-foot and 7-ft. cross-arms are used, and 6-ft. bayonets are substituted for the shorter lengths which carry the ground wire in the case of the single-circuit construction. In general requirements, however, the standards of the two forms of construction are similar. Of the double-circuit pole lines only a few miles have been erected, chiefly in approaches to town substations or plants where it is desirable to minimize pole settings in the struts. Wherever possible, also, such lines pass through the outskirts of the towns they reach.

In ordinary cross-country construction there is little use for the two-circuit lines, since the company's wise policy, whenever a second transmission circuit becomes necessary, has invariably been to build the second line around by another route, thus securing a valuable safety factor in the duplicate supply of energy to the community from two different sources.

As the map shows, it is the aim to develop the present transmission system into such a network, so that practically any point can be fed from a second direction in case accident or breakdown invalidates one source of supply. As the construction of branch transmissions progresses it will be possible to close up many such loops by building connecting tie lines between the outlying termini.

Standard Indoor Substations for Larger Towns

For housing the transformer equipment used to step down the 33,000-volt line potential to the local 2300-volt distribution pressure, several types of standard substation designs have been formulated, toward which all new construction is being conformed. For comparatively large communities there is the 900-kw type of substation shown in Fig. 13, designed to contain three transformer units of 100-kw to 300-kw rating. A similar but smaller indoor substation building is provided for transformers of 50-kw to 100-kw rating. For units of 50-kw rating and smaller outdoor steel-tower mountings are employed.

The larger indoor type of substation, as shown, calls for a brick building 23 ft. x 31 ft. with concrete roof supported on steel I-beams 17 ft. above the floor. Vertical-type entry insulators are employed to admit the 33,000-volt line conductors, which pass directly to the horn-gaps and aluminum-cell lightning arresters at one end of the building. A right-angle tap leads through the choke coils to the transformer primary buses which are ranged along one side of the room. On the other side space is provided for the constant-current transformers or rectifier sets for the local arc-lighting service. Opposite the lightning-arrester units may be installed feeder regulators. All high-tension bus construction is of copper tubing supported on pin-type insulators carried on pipe-frames. For the high-tension circuits automatic 33,000-volt oil switches are employed. The 2300-volt automatic switches on the secondary side are arranged with series trip coils.

With slight modifications the smaller indoor substations are generally similar to the buildings just described.

Outdoor Type of Substation for Small Communities

Particular interest attaches to the outdoor substations which are being installed in many of the small communities of the system whose load does not justify the erection of a regular substation building. Nearly thirty of these

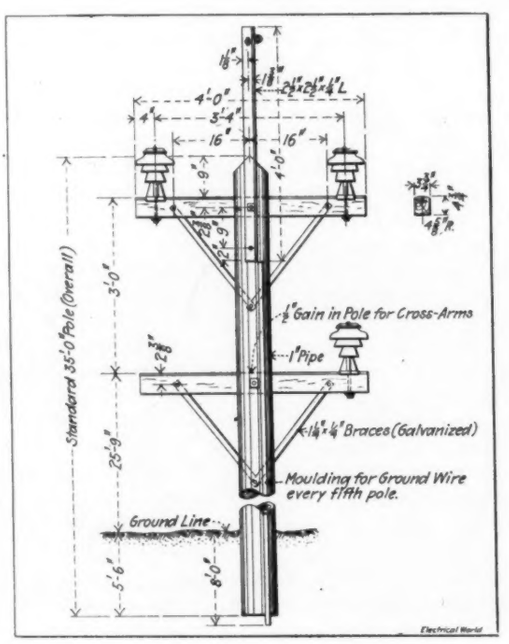


FIG. 6—STANDARD SINGLE-CIRCUIT CONSTRUCTION

structures are either now in place or in process of erection at various points on the system. They are designed to house transformers having ratings up to 50 kw.

As the sketches show, the substation structures are essentially square skeleton towers 24 ft. high, formed of four 3-in. by 3-in. by 0.3175-in. steel angles braced with crosspieces and diagonals. At a point midway of the height, and

approximately 13 ft. above the ground level, is an 11-ft. by 6-ft. platform for supporting three single-phase, self-cooling transformers of any rating up to 50 kw.

At the top of the structure, 26 ft. above the ground, are mounted the horn-gaps for protection against surges and the choke coils in the entry lines leading to the 33,000-volt transformers. Inserted in the lines are very light fuses designed to be blown at a few amperes.

As first erected the transformer equipment in these outdoor substations has been exposed to the weather, but the upper sections are later to be inclosed by corrugated sheeting.

An 8-ft. by 8-ft. reinforced-concrete slab with foundations extending 4 ft. 6 in. into the ground forms the base of the steel structure, whose corner angles are bolted to splicing legs previously embedded by template in the concrete of the foundation. The top of the base is 18 in. or more above the ground and forms the floor of the inclosed switch house, which in some of these substations occupies the space between the four tower legs. Room is here provided for the switch panels and oil switches controlling the local distribution service, besides affording a place to install a constant-current regulating transformer if required for the town street-lighting service.

For primary distribution 2300-volt, three-phase circuits have been adopted as standard. For single-phase secondaries the 110-220-volt, three-wire arrangement is employed, with all secondaries thoroughly grounded at the transformers.

Drainage Pumping as a Central-Station Load

In the valleys of the Illinois and Mississippi Rivers there is an area of 250,000 acres of rich and valuable farm land which on account of its depression below the normal water levels of the streams during part or all of the year must be drained by pumping. Of the total available area 148,000 acres have already been reclaimed by the installation of pumping plants, most of which have heretofore been steam-

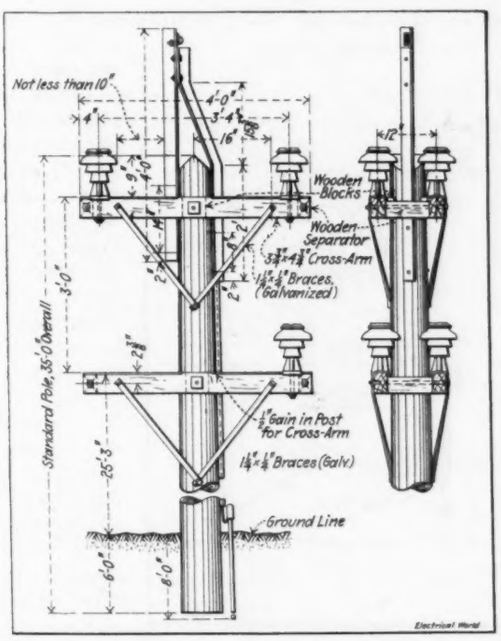


FIG. 7—DOUBLE-ARM TWO-CIRCUIT CORNER CONSTRUCTION

driven. In the electrification of these drainage outfits a start has already been made, however, by putting 6000 acres under electrified operation at the present time, while 20,000 acres additional are now contracted for to be drained by electric pumping as soon as the equipment can be installed.

Tests have shown the average consumption of such motor-driven drainage plants to be about 23 kw-hr. per acre per year at a combined pump and motor efficiency of 50 per cent. The total quantity of water to be carried off during the twelve months is equivalent to 10 in. of rainfall, and this discharge has to be lifted from 10 ft. to 12 ft.

If the drainage of the entire Illinois River valley were electrified it has been estimated that the maximum demand of the pumping load would aggregate 5700 kw, while the

FIG. 8—TRANSMISSION LINE PARALLELING RAILROAD, TAYLORVILLE TO AUBURN

total consumption would run about 58,000,000 kw-hr. of energy per year.

From 60 to 75 per cent of the total year's pumping is now ordinarily required to be done during the three months from March 15 to June 15, while over the rest of the year there is about evenly distributed the remaining 25 to 40 per cent of the consumption. From this it will be seen that the drainage load offers a most desirable load-factor, both with respect to the diminishing need of energy for lighting after March 15 and also on account of the reduced operation of the coal mines during the spring months. This valuable element of diversity between the pumping and mining loads thus enables practically the same station and system equipment to be devoted to first the one and then the other application, reducing investment costs and raising the system load-factor.

Most of the drainage operations in the Illinois River bottoms are carried on by farmers' associations co-operating to install the pumping equipment and to maintain its operation. If, by the Illinois statute, 51 per cent of the farm owners in a given drainage district demand the installation of such a pumping plant, the remaining 49 per cent can be assessed for their proportional share of its cost.

Motor-driven single-stage centrifugal pumps of 200-hp to 250-hp rating make up the bulk of the electrified pumping stations in the Illinois districts. The plant is usually located at the lowest point of the district to be drained, the water being collected, by a system of canals, ditches and tiled drains, from the submerged land, which is protected from the river by levees and dikes.

Savings Resulting from Electric Operation

Compared with drainage by Corliss or four-valve engine-driven pumping plants which cost $100 per hp, equivalent installations of induction motors operating centrifugal pumps have first costs of only $55 to $70 per hp. On ac-

count of the high operating efficiency of the electric equipment, even in the smaller sizes, it is also practicable to divide the station pumping apparatus into three units, improving the flexibility of operation and more accurately adjusting the pump capacity to the amount of work to be done during minimum periods.

Electric pumping plants occupy hardly half the space required by steam stations. They may be started without delay and operated without the presence of an attendant or skilled engineer. Additional motor equipment can be added on short notice if the drainage needs of the district require it. Furthermore, the electric pumping station is subject to small depreciation and need for repairs, and besides lubricating oil no supplies or fuel have to be delivered to or stored at the plant. Fire risks are, of course, reduced by the elimination of furnaces and boilers. High pump efficiencies are also attained by reason of the higher motor and pump speeds available with electric drive Steam pumping plants often require as many as seven attendants when operated twenty-four hours a day, while one man can perform all necessary work about the largest electric drainage station.

During the minimum pumping seasons the control of the pumps can be made entirely automatic by means of float-operated switches. From the owners of the pumping station central-station drive removes all the cares and responsibilities of management and superintendence, at the same time guaranteeing them dependable drainage service at a fixed cost over a number of years. Motor-driven pumping stations can be advantageously located at the best topographical position, without regard to conditions of accessibility for fuel supply, etc.

The average initial cost of installing a system of electric drainage is $2.22 to $2.41 per acre served, which is to be compared with $3.71 per acre for steam pumping plants. Items of labor and supplies in an electric plant will not exceed 16 per cent of the total cost of operation. Since the total cost of pumping in well-designed steam plants is $1.25 per acre per year, it can be shown that, besides all the other advantages of electric pumping, such an electric pumping plant will save money by buying energy at 4 cents or less per kw-hr. The Central Illinois company furnishes pumping service on a sliding energy scale with the quantity steps based on the acreage.

Within 25 miles of the Central Illinois Public Service Company's future generating stations at Kincaid and South Herrin are located practically all of the principal mines of Illinois' two great coal fields, one in the central section and the other at the southern extremity of the State. Besides the 200 mines now being operated within the 25-mile radius referred to, a number of new pits are being opened up.

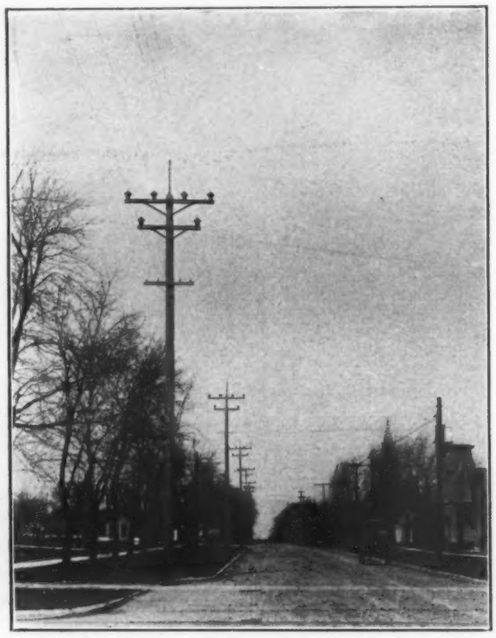


FIG. 9—STANDARD DOUBLE-CIRCUIT 33,000-VOLT LINE

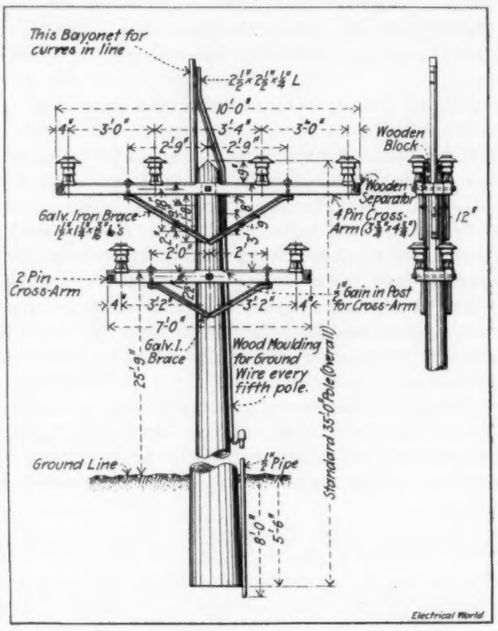


FIG. 11—STANDARD DOUBLE-CIRCUIT CONSTRUCTION

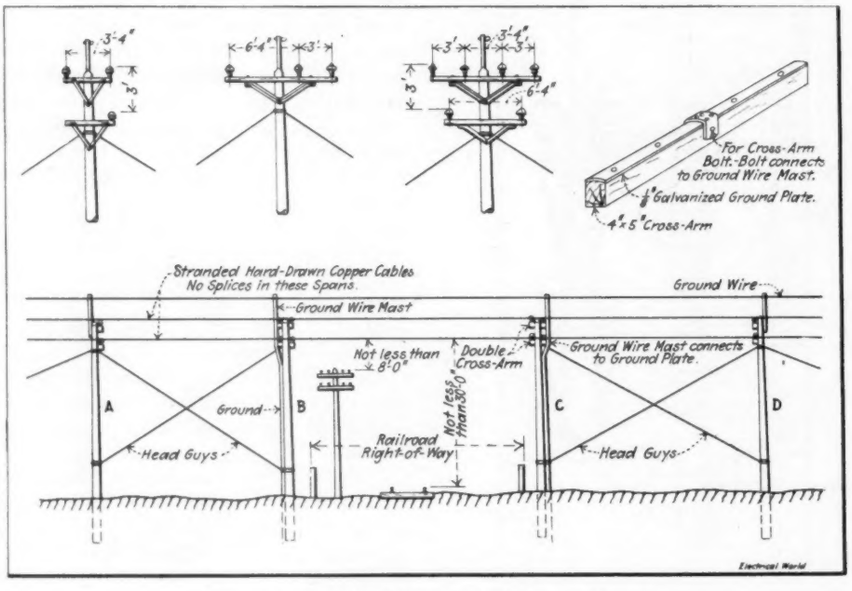


FIG. 10—STRAIGHT-LINE RAILWAY CROSSING

Six of these mines are now being equipped for electric operation, the initial block of power thus contracted for aggregating 5500 hp. Records of electrified operation of mines in these fields have shown that about 1.6 kw-hr. are required for each ton of coal mined under such conditions.

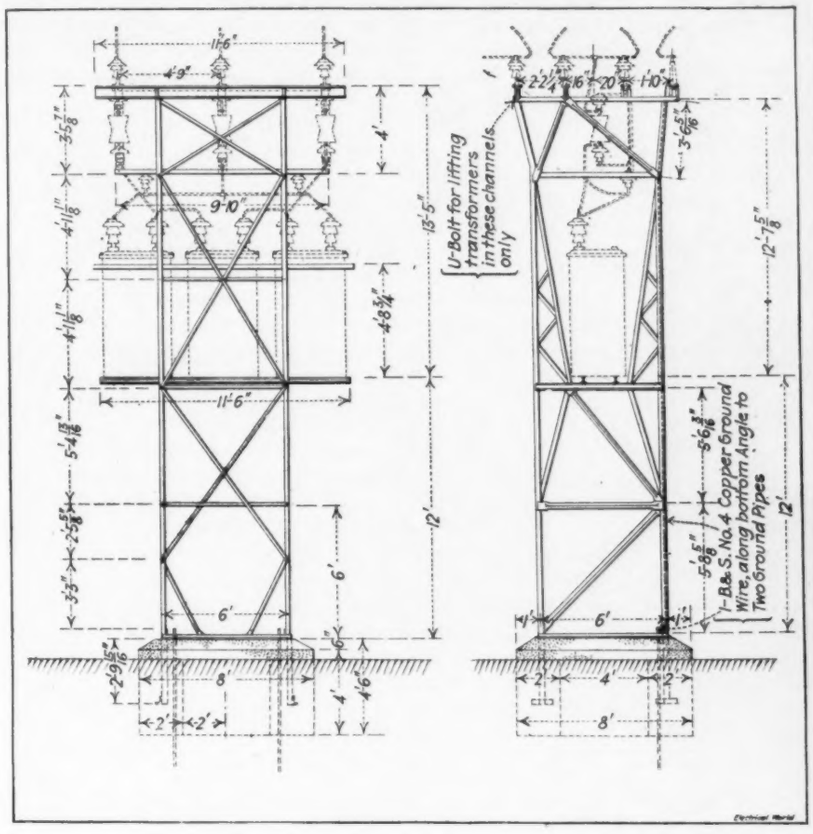

U-Bolt for lifting transformers in these channels only
1-B&S. No 4 Copper Ground Wire, along bottom Angle to Two Ground Pipes

FIG. 12—STEEL SUPPORT AND FOUNDATION FOR OUTDOOR TRANSFORMERS

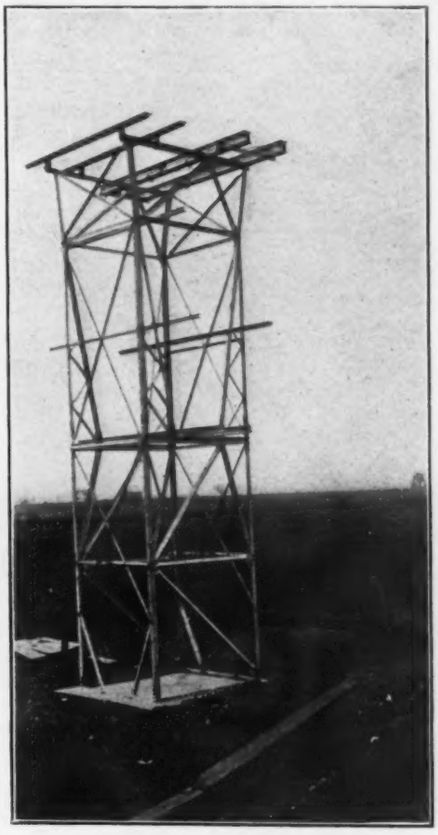


FIG. 14—STEEL TOWER FOR OUTDOOR TRANSFORMERS

Since in the Illinois fields alone some 50,000,000 tons are produced each year, the reader will be able to form some estimate of the possible future demand for electricity.

The average Illinois mine runs eight hours per day during 200 to 2.5 days of the year. Beginning their work at 7:30 a. m., the miners "knock off" about 4 p. m., with the consequence that all mine-conveying machinery is thereafter shut down except various idle loads averaging perhaps 40 kw per mine. This reduced demand then continues on throughout the twenty-four hours. The fortunate timeliness of this interruption to the mining load renders available, of course, an equivalent rating of generating plant equipment to serve the evening lighting peak which follows shortly thereafter. In this way the mining load becomes a good factor in contributing to the diversity of the system.

One large mine in the central Illinois field has contracted to purchase 1500 kw of energy from the transmission company. In this mine substation there is being installed a

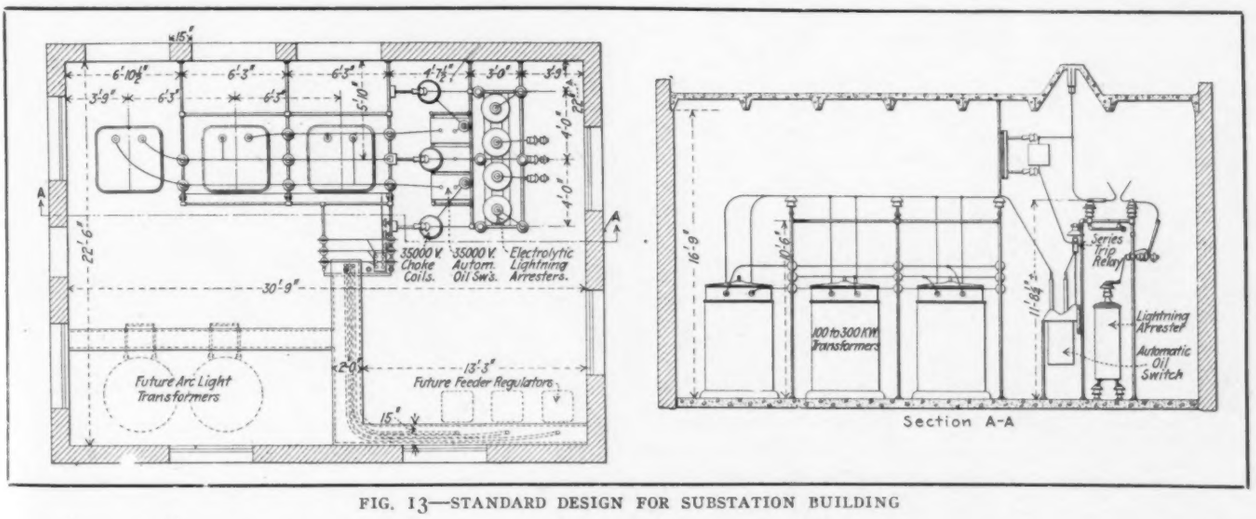


FIG. 13—STANDARD DESIGN FOR SUBSTATION BUILDING

1000-kw motor-generator flywheel set, whose heavy rotating parts will absorb the peaks of demand of the 8-ton hoisting. The 18-ton flywheel will also store sufficient energy to hoist loads out of the 700-ft. pit in the event of momentary interruption to the power supply, and running

idle, it will operate for an hour and a quarter before coming to rest. The hoisting equipment will have a production of nearly 1000 tons of coal per hour during the working day.

Besides the work of hoisting, electricity is used in the mines of this field for operating coal-cutting machines, haulage locomotives, pumps, etc., and for lighting.

To promote the industrial growth of the communities

FIG. 15—DRAINAGE PUMPING STATION AT HAVANA, ILL.

which it serves, the Central Illinois Public Service Company has established an industrial bureau which keeps in touch with the needs of manufacturers desiring to locate factories in its general vicinity. With the co-operation of local civic organizations, the advantages of the various towns supplied with central-station energy from the unified system are pointed out, and the "prospect" is encouraged to build in one of these communities.

To act as director of its industrial bureau, the company plans to secure the services of a man of ability and diplomatic approach, who will be able to meet manufacturers and men of affairs on a common footing, present his arguments with conviction and effect, and "swing" the contemplated factory location for a home town. In accomplishing such valuable promotion work, the management feels that it will be acquiring valuable prospects for its own lines, as well as contributing to the prosperity and welfare of its friends and fellow-citizens.

Up to the present time the company has done little direct advertising of its service, since its lines are new in most of the communities reached and it has yet to complete much of its generating and distribution arrangements before being in a position to promote local campaigns for new business. It has, however, begun using advertising matter on the backs of its monthly statements, encouraging the use of electrical devices, irons, fans, etc. In most of its local offices it also maintains window displays and showroom exhibits of appliances, etc. Moving-picture films loaned by the large electrical manufacturers have also been used with effect to advertise the conveniences and comforts of electricity in the household. Every little community lighted by the company's service has its moving-picture theater, and this method of reaching the local citizenship with films and slides has proved to be one of the best methods of publicity under such conditions.

Commercial Sales Work and Instruction

As already mentioned in the account of company organization, the manager of the commercial department at Mattoon details members of his staff to aid local district superintendents. Although these local salesmen become part of the district-office staff and report to the district executive, they still remain under the control of the sales manager. In his office at headquarters the latter has specialists in the subjects of motor applications, lighting, ice-making, heating, gas service, coal mining, drainage, pumping, etc., whose services are available to aid local salesmen in handling situations calling for special knowledge.

The company's sales staff is recruited from various sources, only experienced men, however, being employed. The principle of civil service advancement obtains throughout the company's organization, the plan being to reward wherever possible continued faithful service with promotion at the first opportunity.

The Central Illinois Public Service Company is one of a number of properties interested in the Central Station Institute recently organized in Chicago with Mr. E. W. Lloyd, general contract agent of the Commonwealth Edison Company, as president. The purpose of this institute is the training of men for central-station sales work by both classroom instruction and field work. Its course is of eleven months' duration, so divided that one month is devoted to each branch of the subject. Students can thus enter on the first of any month, completing the curriculum eleven months later. Following are the general subjects treated: Salesmanship; rates for service; electricity in residences, theaters and on the farm; electric motor-drive and factory lighting; electric signs and decorative lighting; lamps; construction; electricity for stores; accounting and metering; generation and distribution; isolated plants. Class instruction occupies half of each day, the rest of the time being given over to practical experience in outside work in charge of department specialists. The tuition fees are $50 for each of the two terms of the complete course, but the companies to which the students are assigned pay these men a fair rate of compensation for their services during the period of practical field instruction.

While as yet no graduates of the recently organized Central Station Institute have become available, the Central Illinois Public Service Company and the central-station organizations interested in the Institute's work are counting on getting much valuable recruit material from this source.

An Appliance Exhibit on Wheels

The properties of the Central Illinois company will probably be the first to make use of the traveling central-station

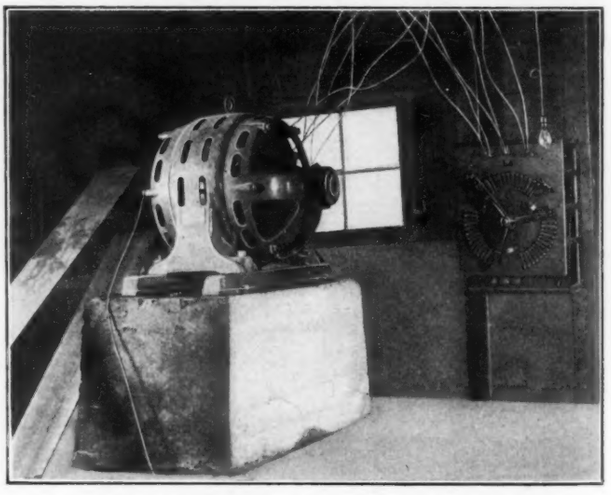


FIG. 16—75-HP MOTOR BELT-CONNECTED TO PUMP IN LACY DRAINAGE DISTRICT

exhibit carried in a special railroad car which has just been constructed for the Middle West Utilities Company, of which the Central Illinois company is a subsidiary. In its exterior design this exhibit car somewhat resembles a standard baggage coach although its interior is made attractive with a complete exhibit of electric lamps, fans, appliances, heating and cooking devices, etc., for demonstrat-

ing the convenience of central-station service. Its width, 9 ft., permits moving-picture shows to be given in connection with lectures at the towns where the car is displayed. One end of the interior is fitted up as a business office. Connection to operate the electrical devices will, of course, be taken from the lines of the local company where the car is on exhibit. The car is without motors and will be attached to regular railroad trains for moving it from one community to another.

House Wiring and Sale of Appliances

Wherever possible the business of selling electrical supplies and wiring houses is left in the hands of the local dealers and contractors, although if good service is not forthcoming from these sources the company will itself prepare to do the work for its customers in accordance with a fixed schedule of unit costs. With the aid of this tabulation

UNIT SCHEDULE OF HOUSE-WIRING COSTS

Main switch and cut-out	$0.75
Drop cord with rosette and key socket	0.75
Flush switches	0.75
Hanging fixtures, each	0.50
Porch outlet work with 6-in. ball and switch	3.50
Three-way switches and switch outlet	3.00
Snap switches	0.50
Center outlets in one-story houses	1.50
Center outlets in two-story houses	1.75
Basement wiring, one lamp and switch	3.00
Basement, additional lamps, each	0.50
Switch openings	1.50

a price can be quickly set for any job so that the customer may know in advance what the cost of the work will be. The contractors are also encouraged to make use of the same unit schedule, rendering the cost of house wiring uniform throughout the system, whether done by the company or local contractors.

Care is taken, however, to preserve all possible cordial relations with the local electrical trade, and this trade receives every advantage in promoting its business of selling fixtures, supplies, etc., and wiring buildings. The company does not aim to sell fixtures itself, although it will furnish them for the convenience of its patrons if for some reason satisfaction cannot be obtained through the local dealer.

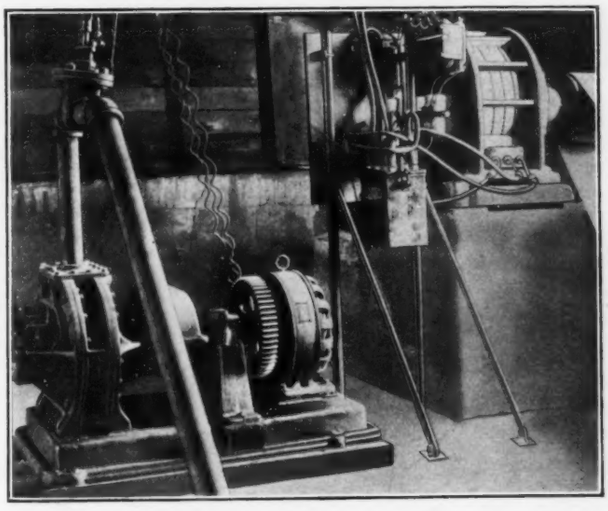


FIG. 17—5-HP PRIMING-PUMP MOTOR AND 75-HP DRAINAGE-PUMP MOTOR

In many of the towns served by the Central Illinois system there is no electrical inspection. In these places the company maintains its own inspection service, which must approve all construction as fulfilling the requirements of safety before connection will be made from the central-station lines. This inspection service is a part of the work of the line-construction department.

In the Central Illinois territory, as elsewhere, electric irons have proved to be the most satisfactory device to handle, the next in order being electric fans and toasters. A number of electric ranges have also been placed, although the company offers no special rate for cooking service besides its secondary charge of 7 cents net per kw-hr., which becomes available after the first thirty hours' use of the

FIG. 18—USE OF ELECTRICAL ENERGY IN SINKING MAIN SHAFT

maximum. Standard 6-lb. electric irons are offered for sale at $3 to encourage the housewives' help in building up the day load.

Rates for Lighting Service

Wherever possible the company is introducing a uniform rate for electric lighting service, although the use of these rates is, of course, affected by the schedule in force at the time the local plant was taken over. The maximum-demand principle is employed in fixing this standard lighting rate by which the customer is charged 14.5 cents (gross) per kw-hr. for all energy consumed up to thirty hours' use of the maximum, beyond which the secondary element is 8 cents (gross) per kw-hr. This 14.5-8-cent gross rate is, however, subject to a prompt-payment discount of 1 per cent per kw-hr. if the monthly bill is settled within ten days of rendering of the statement.

Lamp renewals are not included in the above rate, which covers energy only, the customer being required to buy his own lamps. The company offers, however, a discount of 20 per cent below list on all tungsten and graphitized-filament lamps sold to patrons.

Aspect of Twenty-Four-Hour Service in Small Towns

In most of the smaller communities now reached by the twenty-four-hour service of the unified system the former local plants were operated only during night lighting hours. With the inauguration of all-day service, striking increases have been observed in the kilowatt-hour consumption. While this is in part due to the longer burning hours for the lamps and the daytime operation of some units in dark rooms and on dark days, the major portion of the increase is to be credited to the introduction of electric irons, fans and cooking appliances. The business section of the community also furnishes its quota of demand for the all-day service, taking energy to operate newspaper and job presses, blacksmiths' forge blowers, grocers' coffee grinders, house pumps, refrigerating plants, exhaust fans, etc., and to drive various local manufacturing industries. Motor installations are made, allowing sixty to ninety days' time for payment.

Practically every town and village of the Central Illinois system has its grain elevator—some as many as six. Driven

by 25 hp to 40 hp in motors, such elevators make desirable long-hour day loads for the central station, although their demand comes principally during the winter and spring months.

Town water pumping is another class of business desirable on account of its long-hour characteristics. Where standpipes or other forms of reservoirs are employed the pumping load can be shut down altogether during the peak period. A number of these town-pumping plants are now in operation from the lines of the company, the schedule of charges followed for this service being the regular "power" rate. In eleven communities which it supplies the company itself owns the water-works plants. Electric pumping for railroad water tanks is another application of energy from the countryside network which is being developed by the transmission company.

Manufacture of Raw-Water Ice

Among the local properties taken over were a dozen or more combination ice plants. The largest of these, that at Mounds in the extreme southern part of the State, is steam-driven and has a daily capacity of 200 tons of ice, most of which is shipped to surrounding towns by railroad. A small electric plant is operated in connection with this ice factory, which will probably be continued on its present basis.

Most of the company's combination ice-electric plants are, however, very much smaller, averaging only 10 tons to 15 tons daily capacity, which is usually ample for the supply of their local communities. These plants it is proposed to shut down in most cases, replacing the steam-driven equipment with motor-operated ammonia compressors manufacturing ice from raw water with the aid of an air-agitation system. The demand for ice occurs at a time of year, of course, when the consumption of electricity is reduced to its minimum, so that ice-making affords a profitable seasonable load for the interconnected system. Here again, it is seen, the element of the diversity-factor is on the side of the central station so that a minimum of equipment will be required to operate the summer ice-making load. The decision to use the raw-water system of ice manufacture—although dictated by the lack of distilled water due to the shutting down of local steam plants—is based on the successful experience in Chicago, where several hundred tons

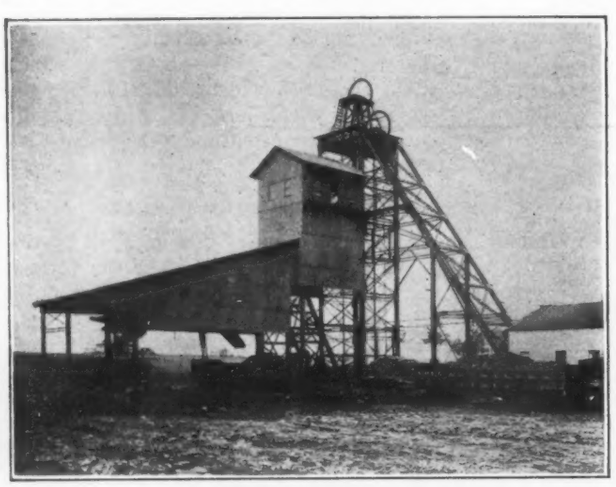


FIG. 19—TYPICAL COAL-MINE INSTALLATION

of ice is being produced daily by electric power, at an expenditure of 45 kw-hr. to 60 kw-hr. per ton of ice manufactcred.

At the present time the Central Illinois company has combination ice plants at Paris, Tolono, Arcola, Charleston, St. Elmo, Macomb, Virden, Carbondale, Marion, Harrisburg and Anna.

Work of the Safety Bureau

The Middle West Utilities Company, of which the Central Illinois Public Service Company is the principal subsidiary, maintains at its Chicago headquarters a bureau of safety. In conjunction with the co-operative fire and liability insurance fund contributed to by the several subsidiary companies at the rate at which they formerly pur-

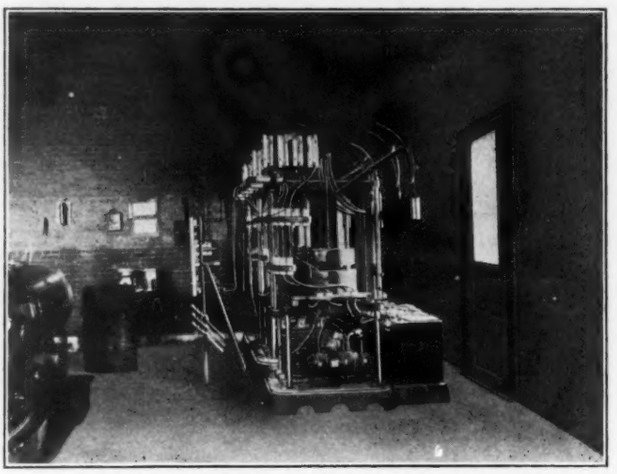


FIG. 20—MERCURY-ARC RECTIFIER EQUIPMENT FOR PARIS STREET LIGHTING

chased outside insurance, it is the purpose of this safety bureau to improve safety conditions throughout the properties and to minimize losses due to fires and to personal accidents sustained either by employees of the company or by others.

Bulletins are sent out at intervals discussing fire hazards and fire protection, methods of prevention, precautions to be taken, use of fire-fighting appliances, etc. Monthly reports are required of local men, detailing on a blank which imposes more than a hundred questions the exact conditions prevailing about the properties which have any bearing on safety. In filling out such a report the operator is thus required to make an extremely complete survey of his property, in this way reminding himself automatically of conditions to be remedied.

An experienced traveling inspector is also employed to investigate local plant conditions and to recommend improvements. In addition the Central Illinois Public Service Company has detailed a man at its Mattoon headquarters in special charge of the safety bureau work in the company's system. At the meetings of district superintendents held at intervals of one to three months addresses are given on the subject of safety and accident prevention. Similar talks are presented from time to time before the local meetings of the district men, who are usually called together once a month.

Among the subjects in which marked improvement has already been accomplished since the bureau's work was started on Jan. 20 of this year are the provision of proper fire hose and extinguishers and pails of sand and water, the elimination of greasy rags from hazardous positions, correction of faulty wiring and improper conditions behind switchboards, screening of transformers and high-tension apparatus, greater cleanliness, etc.

Mr. Marshall E. Sampsell is president of the Central Illinois Public Service Company, and Mr. F. S. Peabody, president of the Peabody Coal Company, is vice-president. Mr. R. B. Donnelly is secretary-treasurer, Mr. G. W. Hamilton is general superintendent, Mr. A. J. Authenrieth is chief engineer, and Mr. J. Paul Clayton is manager of the contract department. Messrs. Sargent & Lundy, Chicago, have acted as consulting engineers for the company in its construction work on plants and lines.

The World's Largest Water-Power Plant

Inauguration of first half of 300,000-hp development of the Mississippi River Power Company at Keokuk—110,000-volt transmission to St. Louis

DEVELOPING 150,000 hp from the Mississippi at Keokuk, Ia.—where the mighty river's flow exceeds by 50 per cent the water passing over Niagara—the initial section of the world's largest water-power plant is now practically completed, and by July 1 it will be transmitting 110,000-volt, 25-cycle energy to St. Louis 144 miles away. To utilize the normal 32-ft. head of the old Des Moines Rapids, now flooded by the new dam, fifteen waterwheel units rated at 10,000 hp each compose the present installation, although the massive concrete substructure for the second 150,000-hp section is in plan awaiting the extension of the plant to its full capacity, 300,000 hp.

Besides the huge power house, 900 ft. long and 133 ft. wide, and the great dam which, 50 ft. high, stretches for a distance of nearly a mile between the Illinois and Iowa shores, the present great project has included for the benefit of river navigation the creation of a lake 65 sq. miles in area, in place of the former tedious rapids and canal; a navigation lock 400 ft. by 110 ft. with a 40-ft. lift—as wide and high as those at Panama; a dry dock 150 ft. by 463 ft., and a river-crossing bridge 30 ft. wide, carried on the piers of the dam structure.

No mere description can give an adequate conception of the magnificent magnitude involved in the work at Keokuk. Although there are other water-power plants whose future extensions will bring them within the range of its horsepower capacity, these are chiefly high-head installations whose physical scale can hardly be compared with the huge hydraulic structures necessary to wrest 300,000 hp from the 32-ft. fall available in the Des Moines Rapids. The Keokuk dam, power house, locks and sea wall, in fact, constitute one huge monolith of concrete extending more than 2 miles from tip to tip.

But the Keokuk development is no less interesting in its numerous features of hydraulic and electrical construction than for its great size. This matter of sheer magnitude, indeed, has introduced many fresh detail difficulties within the main design problems confronting the engineers. The scale of the development and the relatively low potential of the water-power available have resulted in some interesting departures.

Features of the Development

From the standpoint of American practice this is the first large plant to employ low-speed generators directly connected to single-runner turbines. The spiral turbine chambers are also unique in being cast directly in the monolithic concrete of the substructure, without the usual steel linings employed elsewhere. The method of turbine setting was necessarily unusual to withstand the tremendous weights which have to be supported, for each 10,000-hp hydraulic unit weighs 1,000,000 lb., exclusive of the alternator itself.

Again, such, for instance, is the scale on which excitation energy is required by the main units that it is found desirable to generate this energy as alternating current by auxiliary 2000-hp waterwheel sets. In such form it can then be distributed to the various individual motor-driven exciter generators ranged along the 900-ft. power-house gallery, each opposite its own prime unit. The main alternators are then regulated by adjusting the fields of their individual exciters, in

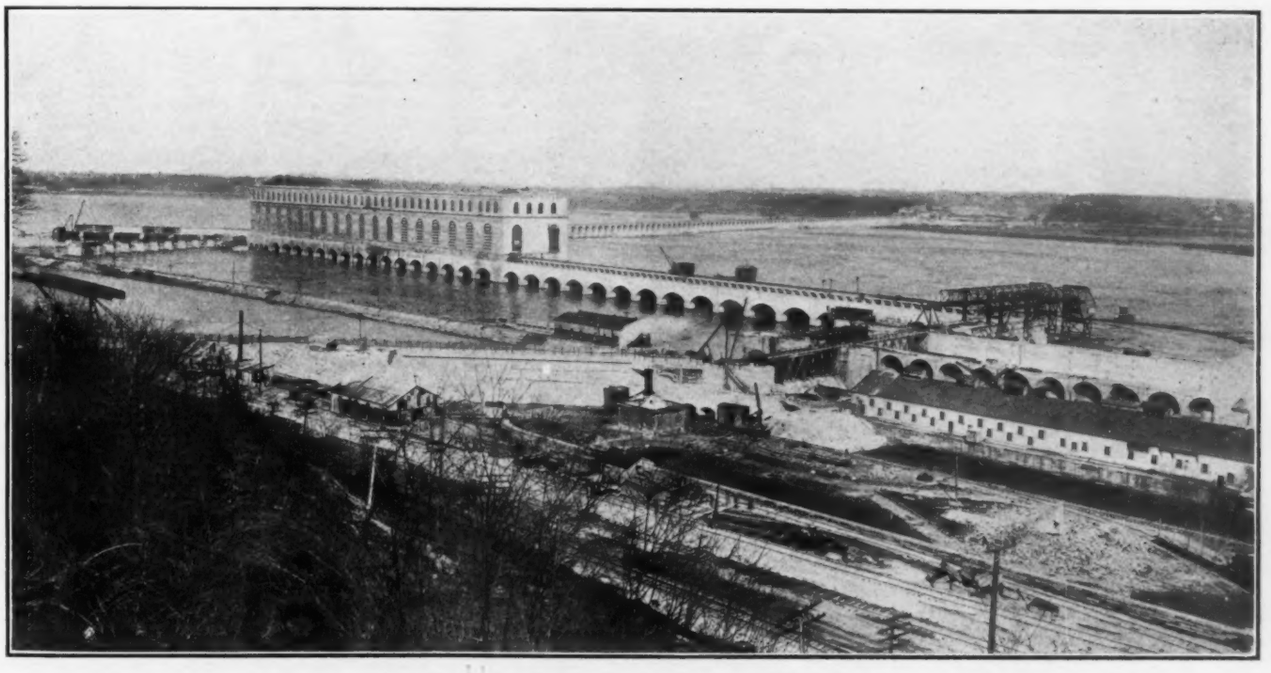


FIG. 1—GENERAL VIEW OF MISSISSIPPI RIVER POWER COMPANY'S 150,000-HP DEVELOPMENT AT KEOKUK, IA.

this way eliminating large field rheostats and energy losses. Practically all switches are of the non-automatic type, the theory having been to "pull through" on lesser faults where possible, without indiscriminate opening of circuits and interruption of service. Cool, considerate thinking of attendants must be depended upon in the final analysis, and the plant layout is designed to encourage this faculty.

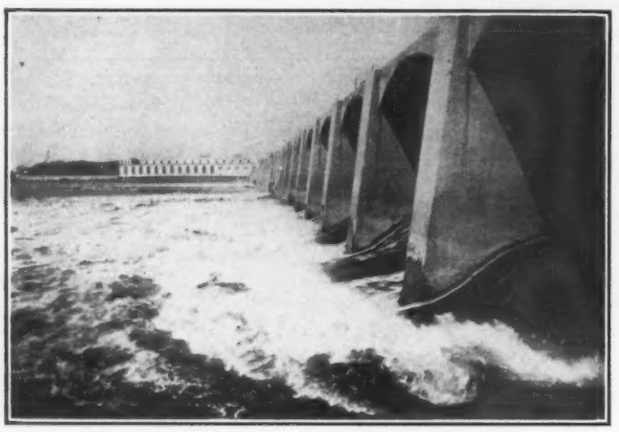


FIG. 2—SPILLWAY, DAM AND POWER HOUSE

While the reactance of the generators and transformers is quite high enough to protect individual units, an interesting use is made of special reactor coils in the section tie links to break up the generator bus into 28,800-kw sections in case of heavy discharge to a fault.

In modern hydraulic and electrical construction the Keokuk plant marks perhaps "the last word" of completeness and excellence, in details as well as essentials. Only "the best" seems to have satisfied the builders, and the result is shown in a monumental installation, altogether worthy of the great "Father of Waters" whose turbid tide it stems. Nearly $25,000,000 has been invested in realizing the dream of half a century—"electric power from the Mississippi"—and to-day the great plant with its graceful dam and imposing power house forms an inspiring picture against the broad reaches of the river.

Construction work on the Keokuk development was started in earnest three years ago, although for forty years

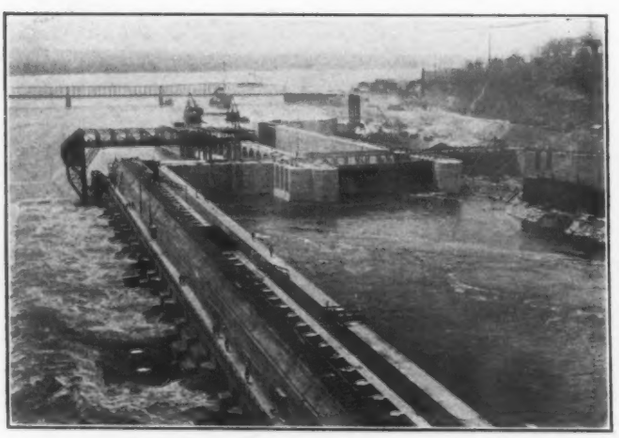


FIG. 3—SUBSTRUCTURE FOR EXTENSION, LOCK AND DRYDOCK

previous thereto various projected plans for a water-power dam and plant had been a topic of local interest

Even Nature herself had favored the purposes of the future hydraulic constructors by a geological caprice a quarter of a million years ago. Recession of the glaciers about that time left masses of drift and débris which choked off the former wide valley of the Mississippi lying to the west of its present channel, so that the river, forced to cut a new course, formed the relatively narrow valley in which it now flows at this point. Instead, therefore, of a valley 5 to 10 miles wide as elsewhere along its course, the distance between the Iowa and Illinois bluffs at Keokuk is little more than a mile. Consequently considerable savings have resulted in both construction and flowage costs.

The 4649-ft. dam, the most conspicuous of the hydraulic structures about the development, is a huge concrete monolith, 4278 ft. in length, not including the east and west abutments, which measure 290 ft. and 81 ft. respectively. It is made up of 119 arched spans, each having 6-ft. piers and 30-ft. openings. Each opening contains a concrete spillway section, on top of which is set an 11-ft. by 32-ft. sliding steel gate for controlling the discharge volume through that section. These gates will be handled by electric cranes traveling on the top of the viaduct. The dam structure is 52 ft. high, 29 ft. wide at the top and 42 ft. at

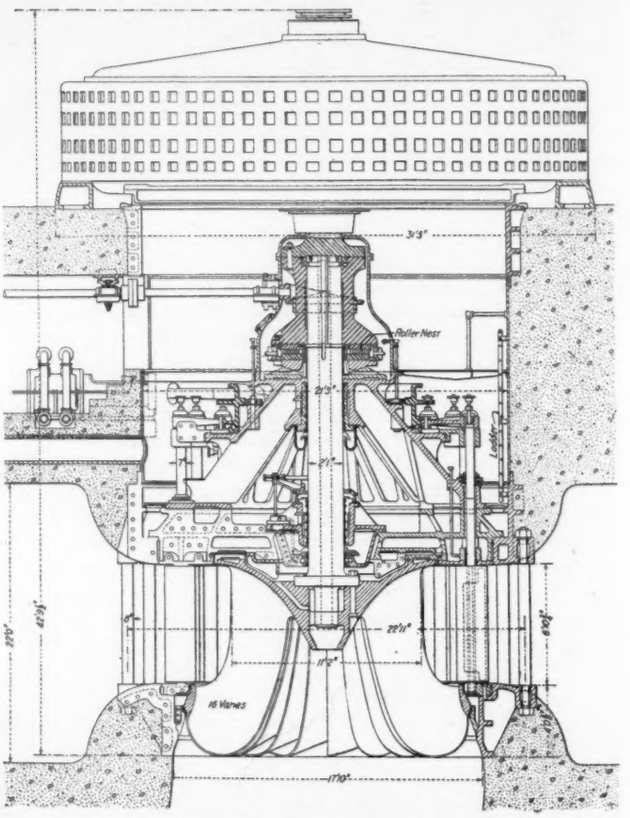


FIG. 4—CENTER SECTION OF MAIN TURBINE

the bottom. Its base is seated on, and keyed for a depth of 5 ft. into, the river bedrock, blue limestone.

The dam is of the gravity-section type, resisting the pressure of the water by its own weight. The up-stream side of the spillway sections is vertical, the down-stream side being rounded into an ogee curve, discharging the flow quietly into the river below. The sliding steel gates have their edges milled to make a water-tight joint with the iron sill plates against which they fit. Approach piers are now being erected, to join the dam viaduct with shore roadways, so that the dam will serve the local community as a splendid river crossing and railroad bridge.

Extending in a gentle curve from the upstream corner of the power house to the Iowa shore is the concrete ice fender which will guard the plant forebay. Of its total length, 2625 ft., 2325 ft. is made up of concrete construction carried on 10-ft. piers, while the remaining 300 ft. will be formed by a floating boom of timbers. The concrete section comprises twenty-nine 60-ft. spans, the top of the structure rising 5 ft. above high water while the openings

are submerged 4 ft. below the low-water level. The fender is 8 ft. wide at the top and 16 ft. across at the base.

Incidental to the raising of the water level of the river above the dam, it has been necessary to relocate on a higher grade a number of miles of the Chicago, Burlington & Quincy Railroad track which skirts the Iowa bluff. A sea wall 1110 ft. long has also been built, varying in height from 45 ft. to 73 ft., to serve as a retaining wall for the newly graded track.

Retaining walls, lock, power-house substructure and dam are all tied together as a single monolith of concrete whose length, 10,560 ft., or 2 miles, measured from end to end, is believed to make it the longest monolith of its kind.

For the entire construction at the Keokuk development site, including the dam, power house and navigation works, about 650,000 cu. yd. of concrete was required, including 650,000 barrels of cement and 300,000 cu. yd. of cement.

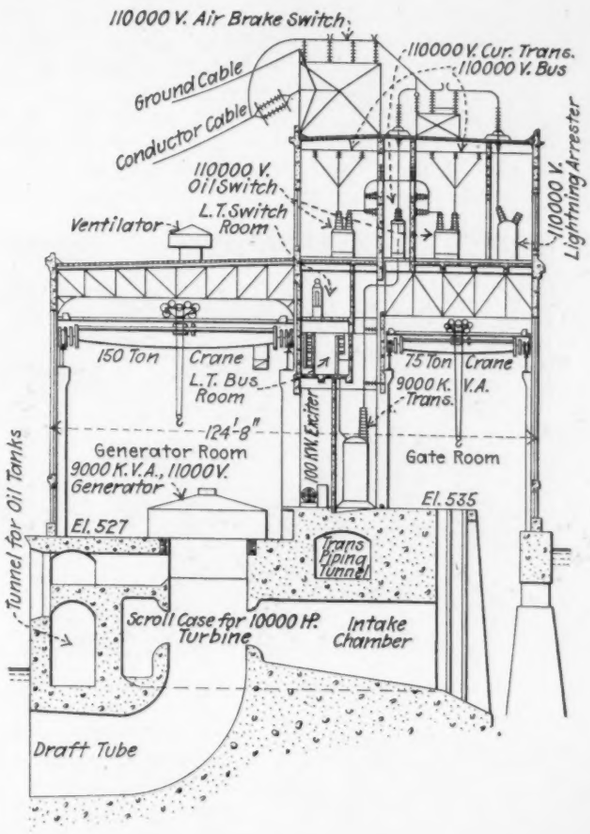


FIG. 5—CROSS-SECTION OF KEOKUK POWER STATION

The standard mixtures employed ranged from 1:3:5 to 1:3:6, the richer being used in special locations.

Navigation Lock and Drydock

In connection with its power-development work proper, the Mississippi River Power Company has constructed and will deed to the United States government free of all cost a 400-ft. lock, 110 ft. wide and having an extreme lift of 40 ft. The upper gates, which are in duplicate, are of the hollow floating type, operated by compressed air. The lower miter gate has twin leaves each 50 ft. by 67 ft. and weighing 300 tons. An entirely separate small water-power plant will also be installed to furnish energy for operating the lock.

Since the Keokuk dam will impound deep water for a distance of 65 miles up the stream, river steamboats will save two hours over the time formerly required to run at reduced speed through the old Des Moines canal with its three locks, and thence on through the shallow channels of the upper river.

Paralleling the lock, there is being constructed the largest dry dock in fresh water, also to be deeded gratis to the government. This basin will measure 150 ft. by 463 ft. Its location at the dam site makes possible, of course, the filling and emptying of the dock without pumping.

As the result of the building of the Keokuk dam and associated structures, and entirely exclusive of the valuable

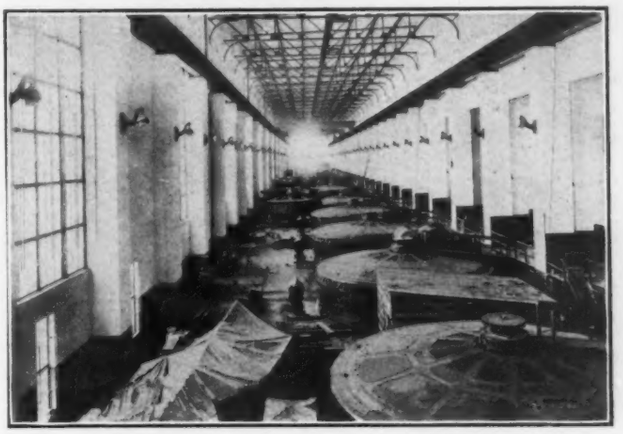


FIG. 6—INTERIOR OF GENERATOR ROOM

lock and dry-dock property it acquires gratis, the government will in future save the annual $40,000 outlay required to operate the old Des Moines Rapids canal, now flooded over by the impounded lake. The capitalized value to navigation of the Keokuk enterprise has been estimated conservatively at from $5,000,000 to $10,000,000.

Concrete Substructure of Power House

The monolithic concrete substructure for the entire thirty-unit power house, 1718 ft. long and 133 ft. wide, is now practically completed, although only the reinforced-concrete superstructure for the initial fifteen-unit installation was erected at this time. The substructure is 70 ft. high, measured to the generator-room floor, while the superstructure adds 107 ft. additional, taken from generator floor to roof. For the substructure foundations excavation was carried 25 ft. below the surface of the blue-limestone bed of the Mississippi.

From the forebay on the Iowa side the water passes

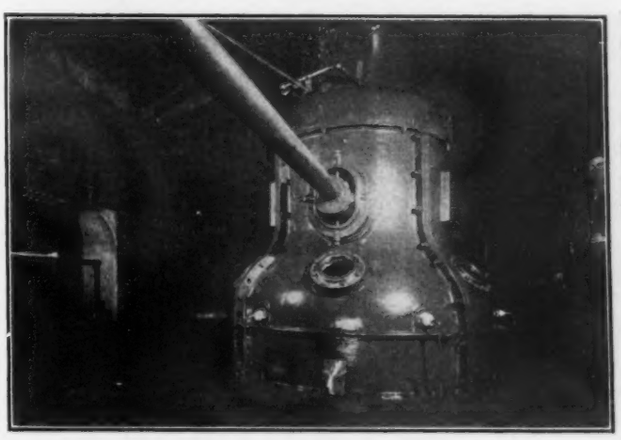


FIG. 7—THRUST-BEARING HOUSING OF 10,000-HP TURBINE

through the racks and gate openings in the gatehouse section of the building, thence entering four branch intake tubes for each 10,000-hp turbine. These four entry openings each measure 22 ft. by 7 ft. 6 in. in section. Three are branch tubes opening into a common passage which delivers water to the scroll chamber at the sides and rear of the turbine setting; the fourth is self-contained up to

the guide vanes, and supplies the front section of the wheel. By the design of the scroll chamber, 39 ft. in diameter, and molded to follow the mathematical curvature required, the water is impinged upon the turbine blades from all sides with equal force and velocity.

The draft tubes leave the bucket wheels as circular discharge openings having a diameter of 18 ft., but rapidly en-

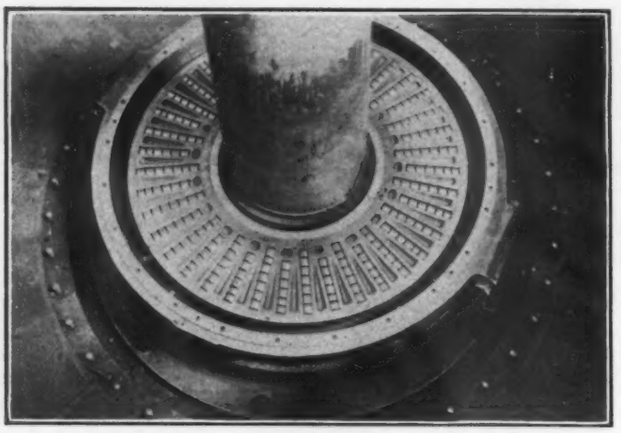


FIG. 8—ROLLER BEARING FOR MAIN TURBINE UNIT

large in section as the tubes assume a horizontal direction to empty into the tailrace. At the final point of discharge the velocity is but 4 ft. per second, or less than 3 miles per hour, assuring quiet entry into the tail-pool. At the top of the draft tube, in the constricted cross-section, however, the water is required to move with a speed of 14 ft. per second, or 9 miles per hour. The tailrace openings from the draft tubes measure 22 ft. 8 in. by 40 ft. 2 in., being made up in section by two semicircles joined by straight lines at top and bottom. The lower edge of these openings, as well as the bottom of the tailrace, is 25 ft. below the bed of the river. The tailrace is excavated to this depth for a distance of half a mile down stream.

The 10,000-hp Turbines

Each of the main 10,000-hp waterwheel units consists of a single 15-ft. runner equipped with balanced guide vanes controlled, through exposed operating mechanism, by a governor on the main generator-room floor. Eight

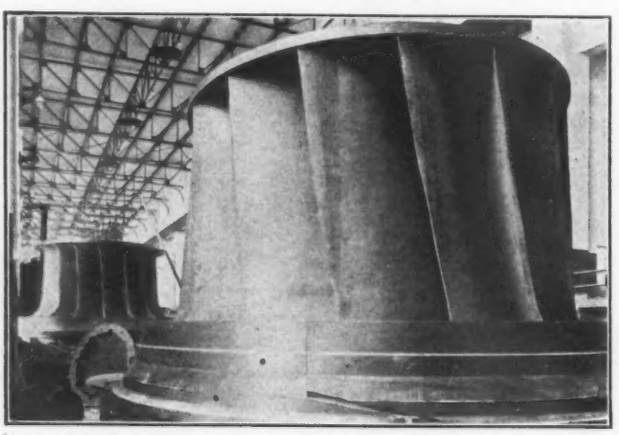


FIG. 9—RUNNERS FOR 10,000-HP WATERWHEELS

of the main turbine sets were built by the I. P. Morris Company, Philadelphia, Pa., the other seven, as well as the pair of auxiliary exciter wheels, having been constructed by the Wellman-Seaver-Morgan Company, Cleveland, Ohio.

The main turbine shafts are 25 in. in diameter and 21 ft. long. With the rotary alternator field in place, the total revolving weight to be carried is 225 tons. This is carried by a thrust bearing and by two main-shaft bearings. On the first twelve machines the Standard combination roller and oil-pressure bearing employed utilizes oil at 225-lb. pressure, which normally keeps the 225-ton load lifted off the rollers. In case of failure of the oil pressure, of course, the load is transferred to the roller bearings. Oil is supplied by gravity to the upper bearings, being thence drained to the reservoir under the lower bearings, from which it is pumped to central-supply tanks. Kingsbury thrust bearings are to be used for the remaining three machines. This new type of bearing requires oil circulation at only atmospheric pressure and introduces a low degree of friction.

The pivoted turbine gates are steel castings with hollow-forged stems which have bronze bearings in the crown and curb plates above and below the gates. Grease lubrication is employed, the lower bearings of the gate stems being fed through holes bored the length of the shanks.

Each main runner carries twenty buckets and weighs 65 tons, while the complete turbines weigh approximately 1,000,000 lb., or 500 tons. The runners made by one manufacturer were cast and delivered in a single piece, while those of the other were built in quarters and assembled at the power house. The latter method necessitated, however, the addition of a steel-cover plate and steel-band

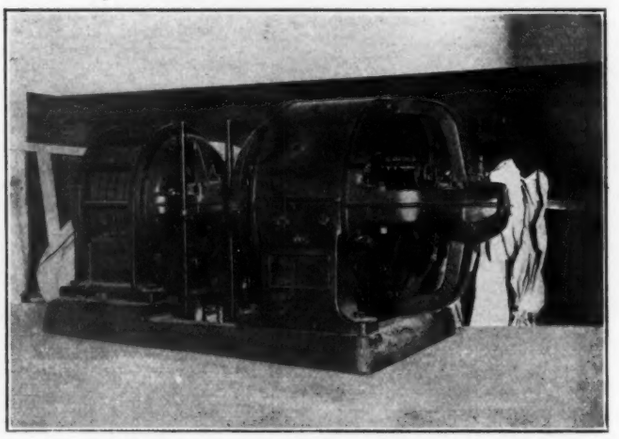


FIG. 10—INDIVIDUAL MOTOR-GENERATOR EXCITER SET

rings, increasing each of these runners' weight by 25 tons.

Conditions of high and low water will cause varying operating heads on the Keokuk plant, ranging from 39 ft. maximum to 20 ft. minimum. For the average nominal head obtained, 32 ft., the turbines are rated at 10,000 hp. At 39 ft., however, each unit will develop 14,000 hp, and at 20 ft. 6000 hp. This low-head condition was a factor in the selection of a turbine speed of 57.7 r.p.m., probably the lowest ever employed in installations of this class. At times of low head it becomes of the greatest importance, of course, to get all possible rating out of the machines at 57.7 r.p.m.

Tests of models of these waterwheel designs, made at the Holyoke flume, have indicated efficiencies of 88 per cent and higher, showing a marked gain over the ordinary efficiency figures obtained for similar units, which range from 75 to 80 per cent. By adopting a double-runner design the speed of the shafts might have been increased to the advantage of the electrical equipment, but as such construction would have rendered the controlling mechanism much less accessible for inspection and repairs, the single runner type was adhered to.

Governing Mechanism for 10,000-hp Units

Of equal interest with the great turbines are the governors which effect their speed control at varying loads. These notable governing devices were built by the Lombard

Governor Company, Ashland, Mass., and are of the oil-pressure type. The governor proper, or actuator, is mounted on the main generator-room floor while the relay valves and regulating cylinders are located on the thrust-bearing gallery at a lower level. In these tunnel compartments are also placed the accumulator and receiver tanks and the triplex pumps which furnish the oil pressure for the control cylinders. The latter pumps are in duplicate, one set being driven from the main machine shaft through chain gearing, while the other group is operated by a separate induction motor. The motor-driven pumps are controlled by a pressure system, starting up only when the oil supply needs replenishing.

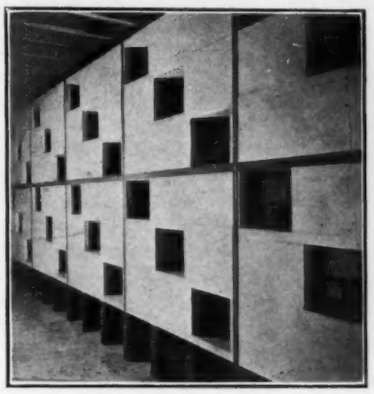


FIG. 11—CONCRETE-SLAB BUS COMPARTMENTS

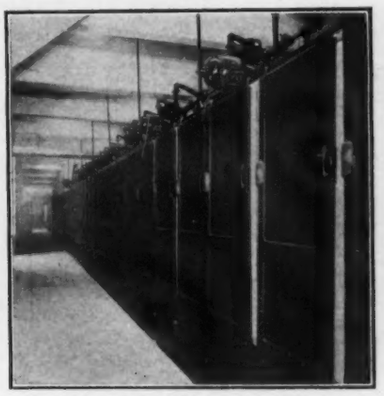


FIG. 13—MOTOR-OPERATED 11,000-VOLT OIL SWITCHES

In the actuator pedestal on the generator-room floor are contained the speed-control element and anti-racing devices which manipulate the sensitive valves operating the large balanced relay valves and thus the oil-pressure cylinders on the floors below. On the face of the governor pedestal are grouped gages showing the various oil pressures, the speed of machine rotation and the amount of gate opening at any instant. A special handle provides also for converting the control of the gate motion from its ordinary automatic cylinder operation to hand manipulation, if desirable. Another valve then controls the gate position, the gates being capable of being moved from full open to closed position independently of the speed of the unit. Of the four brass handwheels on the actuator case, two govern the supply of oil to the valves, while the others serve to alter the speed of the unit by adjustment of the centrifugal device. One of these adjustments is purely mechanical; the other is electrical, its circuit wires being extended also to the main control switchboard on the fourth floor so that the operator there can adjust the governor setting and control the speed of any unit while paralleling, etc.

OUTLINE OF POWER-HOUSE ARRANGEMENT

The power-house superstructure is a reinforced-concrete building measuring 900 ft. by 133 ft. in plan and 108 ft. above the floor line. A longitudinal wall divides it into two compartments, the generator room and the gatehouse, the latter containing also the high-tension transformer cells. Opening to the generator room, but on a raised-gallery level, are the connected compartments containing the exciter sets, auxiliary transformers and switchboards, etc.

On the upper levels are installed the low-tension bus structure and low-tension oil switches and the 110,000-volt oil switches, lightning arresters, buses, etc. On the fourth-floor level at the south end of the present plant, where it will occupy the center of the future completed building, the main controlling and operating switchboard is situated.

GENERATING UNITS AND SCHEME OF EXCITATION

The fifteen main generating units are 7500-kw General Electric 11,000-volt, 25-cycle, three-phase vertical alternators, having their rotating fields carried on the water-wheel shafts and running at 57.7 r.p.m. These huge machines measure 31 ft. 5 in. in outside diameter. In height they extend 11 ft. 3 in. above the generator-room floor, the field collector rings being reached by platforms extending from the side-gallery level, as shown in an illustration.

In addition to these main units there is a pair of 1600-kw "auxiliary" alternator sets whose special function is to furnish 440-volt, 25-cycle energy to operate the individual

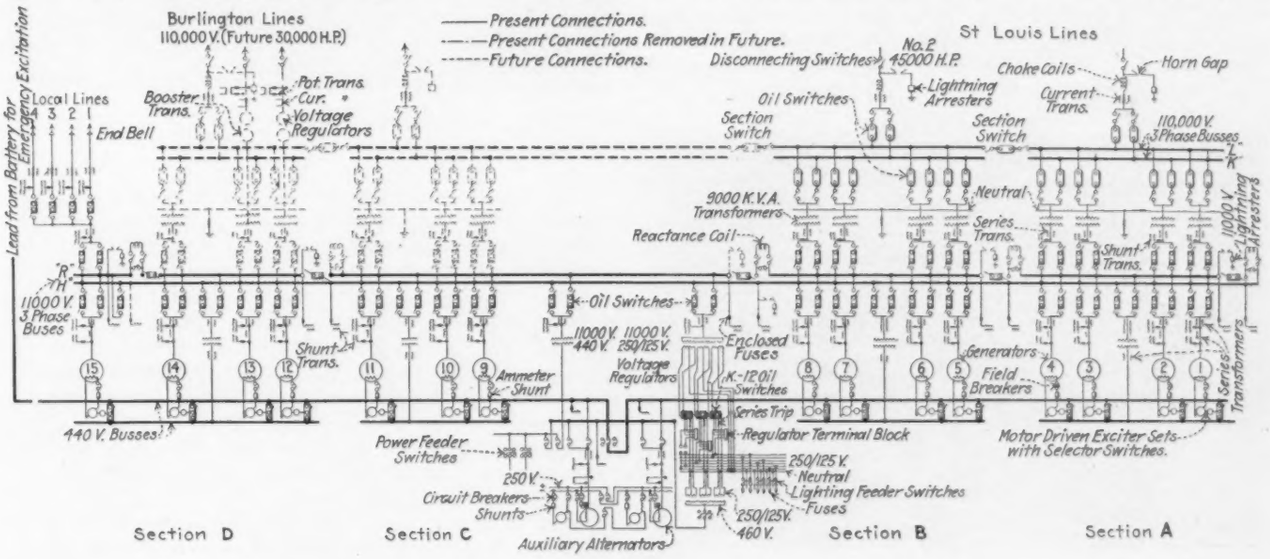


FIG. 12—STATION CIRCUIT DIAGRAM, KEOKUK WATER-POWER PLANT

motor-generator units by which the main generators are excited. These auxiliary alternators are of the same direct-connected vertical type and are driven at 125 r.p.m. Each has its own direct-current exciter mounted on the shaft extension above the alternator, so that the auxiliary alternators can be started up as self-contained units.

In a station building several city blocks in length many

features which would require no special provision in the ordinary plant become, as here, real problems when considerable distances are involved. Thus the use of alternating current for distributing even the excitation energy results in a considerable saving in investment and operation over the direct-current distribution ordinarily employed.

The exciter motor-generator sets can also be driven with 440-volt, 25-cycle energy taken from the main 11,000-volt bus through transformers provided for the purpose, thus

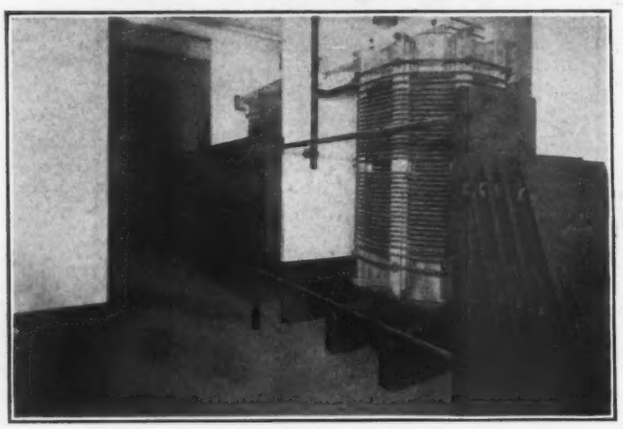


FIG. 14—REACTANCE COILS BETWEEN 11,000-VOLT BUS SECTIONS

giving an alternative source of excitation energy, besides the special auxiliary alternators. In case of emergency, connection can also be established with one of the duplicate 320-amp-hr. storage batteries used for operating the oil switches. Parallel operation of all the Tirrill regulators controlling the exciter fields of the various main alternators is accomplished with the aid of series transformers inserted in the machine leads, so that exchange currents between units are automatically compensated for.

9000-KVA HIGH-TENSION TRANSFORMERS

In the gatehouse section of the building in a separate concrete cell opposite each main alternator is grouped its corresponding 9000-kva, three-phase transformer unit, stepping up from the generator pressure, 11,000 volts, to the transmission potential, 110,000 volts. These trans-

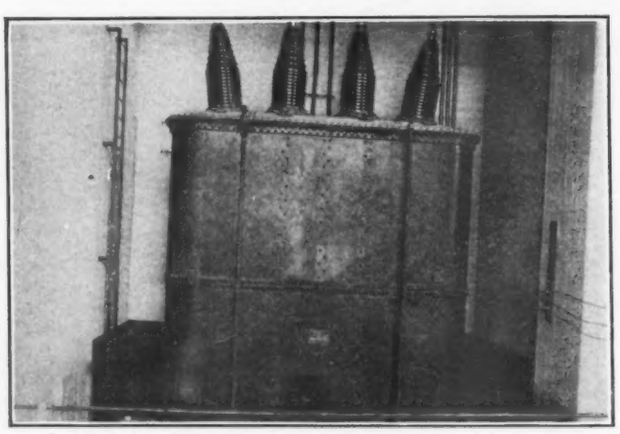


FIG. 15—ONE OF THE 9000-KVA, 110,000-VOLT TRANSFORMERS

formers have star-connected high-tension secondaries, four insulated terminals being brought out, with the neutral lead grounded.

Their huge boiler-steel cases measure 16 ft. by 8 ft. in plan and were shipped to Keokuk in two sections, to be riveted together on the job. The transformers measure over all nearly 25 ft. from the floor to the top of the compound-filled porcelain-and-fiber bushings. The units are mounted on rollers and can be run out from their cells under the traveling cranes of the gatehouse for removal or dismantling in case repairs are necessary. Each of these transformers, complete with core and oil, weighs 123 tons.

The efficiency rating of these 9000-kw transformers is 98.5 per cent, although on account of their great size the dissipation of the remaining 1.5 per cent as heat requires 56 gal. of cooling water per minute.

Pipe connections to the bottom of the transformer cases permit filling or emptying the tanks while in position. The 4-in. supply line for admitting oil is controlled by a gate valve whose hand-wheel is inclosed in a glass-covered box in the generator room. Similarly, the quick-opening valve in the 6-in. discharge line is also extended through the wall to a hand-lever which can be easily reached in emergency, for dumping the $2,500 oil contents of the transformer into the tailrace if made necessary by fire peril.

There are duplicate pipe systems of circulating water for cooling the transformers, the valves and visible discharge nozzles of each unit being mounted on the generator-room side of the wall opposite its cell and under the direct supervision of the generator-room operators.

While each alternator is closely grouped with its 9000-kva transformer, both in its position and its operation, connection of the two, as the accompanying diagram shows, is actually established through means of the duplicate

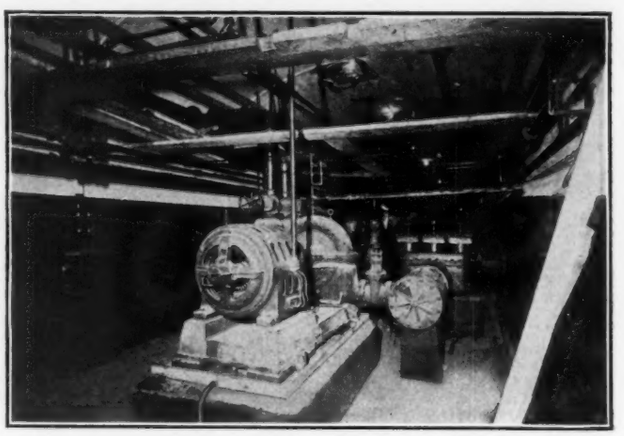


FIG. 16—1000-GAL.-PER-MINUTE PUMP FOR TRANSFORMER COOLING WATER

11,000-volt buses, to which General Electric H-6 motor-operated oil switches connect both generators and transformers. Four generators and four transformers constitute a section, one such section feeding each of the two St. Louis circuits. Another unit is to be ordinarily devoted to the local Keokuk service, and the remaining six will serve the Fort Madison and Burlington circuits, which are operated at the generator pressure, 11,000 volts.

REACTANCES AND PROTECTIVE FEATURES

The 11,000-volt bus is in duplicate, the "long bus" extending solidly through the station while the short bus is broken up into sections each of which groups together three or four generators and transformers. These sections are tied to one another by automatic oil switches and reactances which limit the flow of current from one section to another in case of a fault. The reactances, it will be especially noted, are not inserted in the generator leads but are located in the tie links between bus sections or groups of four generators. The reactor units are constructed of 1-in. copper cable wound on wooden forms and are adjustable for a reactance of 4, 6 and 8 per cent at 9000 kva.

Owing to the slow-speed design of the main alternator, it has been possible to include considerable reactance in the windings of the large machines themselves so that on

short-circuit these units will deliver only from three to five times their normal full-load output. The transformers are also wound for 5.7 per cent reactance.

While it is evident that the individual units are thus well protected against the occurrence of heavy discharges in case of short-circuit, the sheer size of the whole plant is such, however, that the total short-circuit output of a number of these machines might cause tremendous damage.

It is here that the busbar reactors prove of service. Through them the total current input into a dead short-circuit on the low-tension bus is limited to a maximum of from thirty to forty times the full-load current of one generator unit, depending upon the per cent reactance used on the busbar reactors. The total current is independent of whether the station consists of the present fifteen or the ultimate thirty units; that is, only half of the units in the ultimate station will be affected by a dead short-circuit in the low-tension bus. The total short-circuit current, it will be noted, is equal to that given out at instant of short-circuit by only two turbo-generators, each equal in rating to those at Keokuk.

In case of a dead short-circuit on one of the high-tension lines close to the power station not more than two sections on each side of the one short-circuited will be affected. This result is attributable to the intervention of the transformer reactance in series with the reactance of the busbar reactors. The total current input into a short-circuit,

FIG. 17—HIGH-TENSION SHAFT CONNECTING BUS STRUCTURE AND TRANSFORMER COMPARTMENTS

whether high-tension or low-tension, due to the high generator reactance is practically the same whether taken at the instant of short circuit or after considerable time delay.

Thus it is immaterial as far as concerns the rupturing capacity of the oil switches whether they open short-circuits instantaneously or after some delay. Instead, however, of utilizing this feature as an excuse for short-time opening of short-circuits, it was decided to make use of the long time required to overheat any apparatus to the danger point by using non-automatic switches in the direct line between a high-tension circuit and its source of supply. To this end the only automatic main switches in the station are the outgoing low-tension line switches and the low-tension bus-sectionalizing switches.

The bus-sectionalizing switches are opened by inverse-time-limit relays operated by the current in the transformers connected to an outgoing line, so that in a case of line trouble the section affected will be automatically isolated. Operation with non-automatic switches is extended as far as possible over the transmission system, as it is hoped thereby to eliminate a source of trouble and failure.

The settings of bus-sectionalizing switches are rather high in order to defer the opening of the circuit until no possibility remains of clearing up the trouble easily. This feature not only gives the attendant time to think and act coolly and to best advantage, but it is a precaution to prevent indiscriminate "killing" of the line needlessly for slight troubles, with the consequent annoyance to customers, shutting down of synchronous apparatus, etc. As long as the tie switch remains closed, however, the reactance not only limits the cross-flow of current between sections but also assists in holding up the voltage on the other sections from which current is being taken.

The reactances of the different reactors are so proportioned that the bus voltage on a section adjacent to the one short-circuited will always be higher than 75 per cent of normal voltage. By parallel operation of all generators, therefore, there is obtained without spreading disturbances to adjacent sections a stability in operation and a flexibility which reduce to a minimum the duplication of equipment required to maintain reliable service.

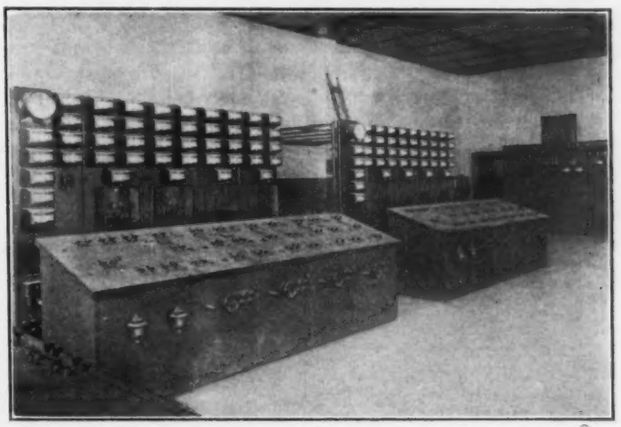


FIG. 18—CENTRAL SWITCHBOARDS FOR ST. LOUIS SECTIONS

An additional automatic feature, intended to secure the quickest possible clearing of such troubles as arcing grounds or crosses, is a special contact in the Tirrill regulator so arranged that the opening of the oil switch will introduce reactance into the generator excitation, at once depressing the voltage in the group and line so that the arc will go out from lack of potential to sustain it. By this means it is hoped to clear a certain class of troubles without even interrupting the operation of customers' synchronous machines, whose rotating inertia will carry them over until full voltage is restored.

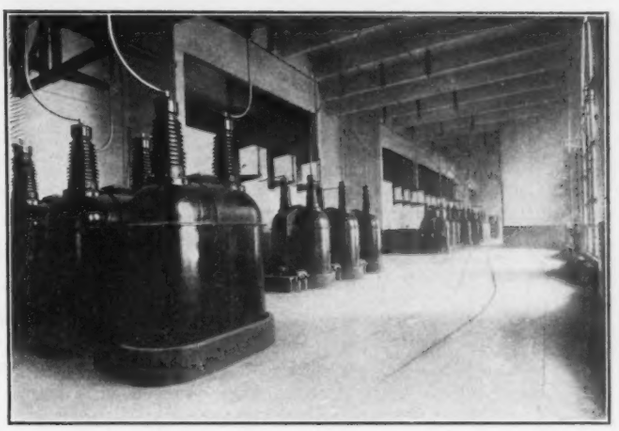


FIG. 19—110,000-VOLT OIL SWITCHES FOR ST. LOUIS LINE

As already noted, operating control of the alternators is centered in the switch room, which is on the fourth story and at one end of the station, out of sight of the generator room except as visible from a connecting inspection gallery. To enable the floor operator to disconnect his generator without delay in case he discovers imminent trouble, dupli-

cate emergency cut-out switches are provided at each machine station, one being on the main generator floor and the other at the side of the exciter gallery. By breaking the glass cover the attendant can reach and close the remote-control switch within, which instantly both removes the machine from the bus and disconnects its field supply, thus totally isolating the unit.

11,000-Volt Buses and Oil Switches

The 11,000-volt bus compartments are on the second story, the General Electric H-6 oil switches being mounted on the floor above. Concrete-slab construction has been used in these bus structures, the 1.1 mile of compartments thus far erected having required 3200 of the molded slabs. For the buses copper of rectangular section, 3.5 in. by 0.375 in., has been employed, being mounted on Thomas porcelain pedestal insulators of special local design. Series and potential transformers for the instruments are similarly inclosed in concrete-slab barriers.

The 11,000-volt oil switches are of the motor-operated type and are rated at 300, 500 and 2000 amp. Directly below the oil switches are the corresponding disconnect switches. These disconnectors are arranged with special locking devices holding their blades securely, in either the closed or the open position, against accidental or automatic movement.

Not only are all the oil switches themselves clearly labeled, but the three phases are also lettered. And on the barriers between the separate switches broad red lines have been run, marking distinctly the respective switch-cell groups so that by no mistake can a wrong trio be accidentally chosen. It is also of interest to note that the extreme length of the busbars in the Keokuk plant has made necessary special provision to take care of the expansion and contraction which occur with changes in temperature.

Sand pails and Pyrene holders are provided throughout the bus structures, and every precaution is taken against fire.

110,000-Volt Structure

From the high-tension terminals of the 9000-kva transformers on the first floor of the gatehouse the 110,000-volt leads are carried up through spacious concrete air shafts to the high-tension switches which connect to one or the other of the duplicate 110,000-volt buses. Two-inch galvanized-iron pipe coated with bronze paint forms the main high-tension buses, which are supported on suspension insulators each made up of seven 10-in. disks. For branches and leads to the oil switches 1.25-in. pipe is used. For pipe connections special union couplings are employed sweated to insure good contact. In the case of the vertical risers in the shafts the high-tension pipe is supported on seven-part pedestal insulators mounted on the side walls.

High-tension disconnect switches with 4-ft. blades enable the oil switches to be isolated from the transformers. The hook stick with which these disconnect switches are handled is provided with a ground ring just above the operator's handle. This ring is attached to a cable and clip which must be affixed to a nearby ground connection each time the stick is used.

The "long" high-tension bus has a tie switch for interconnecting the two 110,000-volt sections, while the "short" bus is in each case limited to the four-unit sections.

All of the high-tension oil switches are of the General Electric K-15 solenoid-operated non-automatic type. The switch tanks measure 3 ft. by 6 ft. by 6 ft. and, complete, the switches weigh 4 tons each.

For convenience in operation the plan of distinctly labeling all apparatus, followed throughout the whole plant, is also carried out here, the various transformers, tie and line oil switches being all marked. A float gage shows the oil level in each switch tank, and pipe connections with quick-operating valves permit the contents to be replenished or discharged in case of fire. All oil piping in the building is painted a gray color, and the inlet and discharge lines are labeled in large letters.

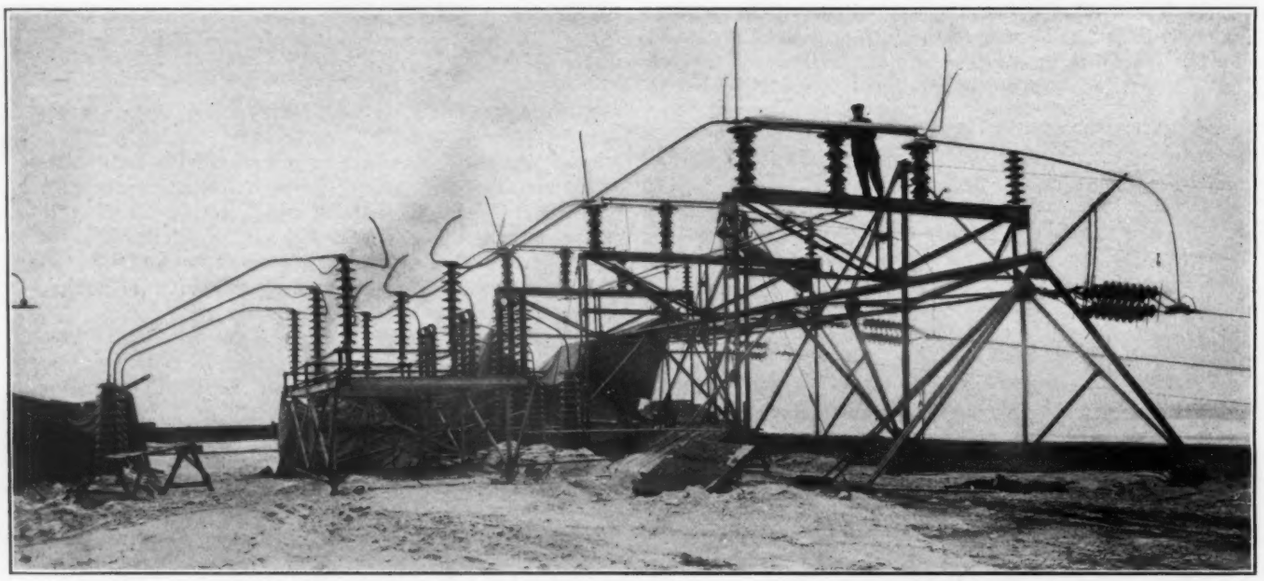


FIG. 20—110,000-VOLT ARRESTER GAPS AND AIR-BRAKE SWITCHES, KEOKUK PLANT

Inserted directly in series with the main outgoing 110,000-volt line circuit are the current transformers, whose secondaries are led to armatures in the switchboard room, reading directly the amperes per phase for each high-tension line.

High-Tension Roof Structure

The vertical porcelain roof bushings through which the high-tension circuits leave the switch room measure 12 ft. in length and several feet in diameter. Pairs of 300,000-circ.-mil helical choke coils, mounted on the roof structure, are inserted in each phase wire at a point just below the tops to the lightning arresters.

For wholly disconnecting the transmission lines from all the high-tension apparatus of the building pivoted air-break switches are mounted on the roof structure. These Pacific Electric switches have centrally pivoted arms 12 ft. in length, ending in vertical horn-gap members which aid

in interrupting the charging current when the line is opened. The actual carrying contacts in the closed position of the switch are spring clips which engage stationary members.

The three switches of each circuit are manipulated by a single crank lever worked from the roof. After the switch members have been opened, ground connections are applied to the line wires by raising grounded switch arms. In this way complete discharge and "killing" of the line is assured when the switches are opened.

A marine-type weatherproof telephone station and a 500-watt tungsten lighting standard are adjuncts to the high-tension roof equipment, for the convenience of the men operating this apparatus.

From the span wires and air-break switches a straight path is provided back to the lightning-arrester horn-gaps, the main busbar connections being tapped off at right angles. The arrester gaps are of the double-horn type with charging resistors connected between the upper and lower sets of horns. The cross-connecting device for charging the arresters can be manipulated by lever handles both on the roof and in the fourth-story compartment where the electrolytic cells are installed. There are four of these huge General Electric aluminum-cell arresters in each set, three being connected in star to the phase wires and the fourth forming a ground connection to the neutral point which is thus established. In all approximately 500 aluminum cones are contained in each one of these 110,000-volt arrester cells.

Throughout the high-tension installation a safety factor of three to one has been maintained both mechanically and electrically. The roof bushings and suspension insulators, for example, are capable of withstanding 330,000 volts even under wet test. Minimum clearances of 3.5 ft. to ground and 5.5 ft. between phases have been used in the 110,000-volt bus connections.

Operating Switchroom

As already mentioned, the operating control of the station is centered in the switchroom at the south end of the fourth floor, a position which will later become central with the extension of the plant to its full equipment of 30 units. There are separate benchboards for the remote-control manipulation of the two southbound circuit groups and each of the machine groups for northbound and local circuits. All bus connections are diagrammed on these benchboards and the positions of switches shown by pilot lamps. Control buttons for the switches are also interlocked against accidental misconnections. The governor control circuits are also brought to these operating positions for paralleling and similar operations.

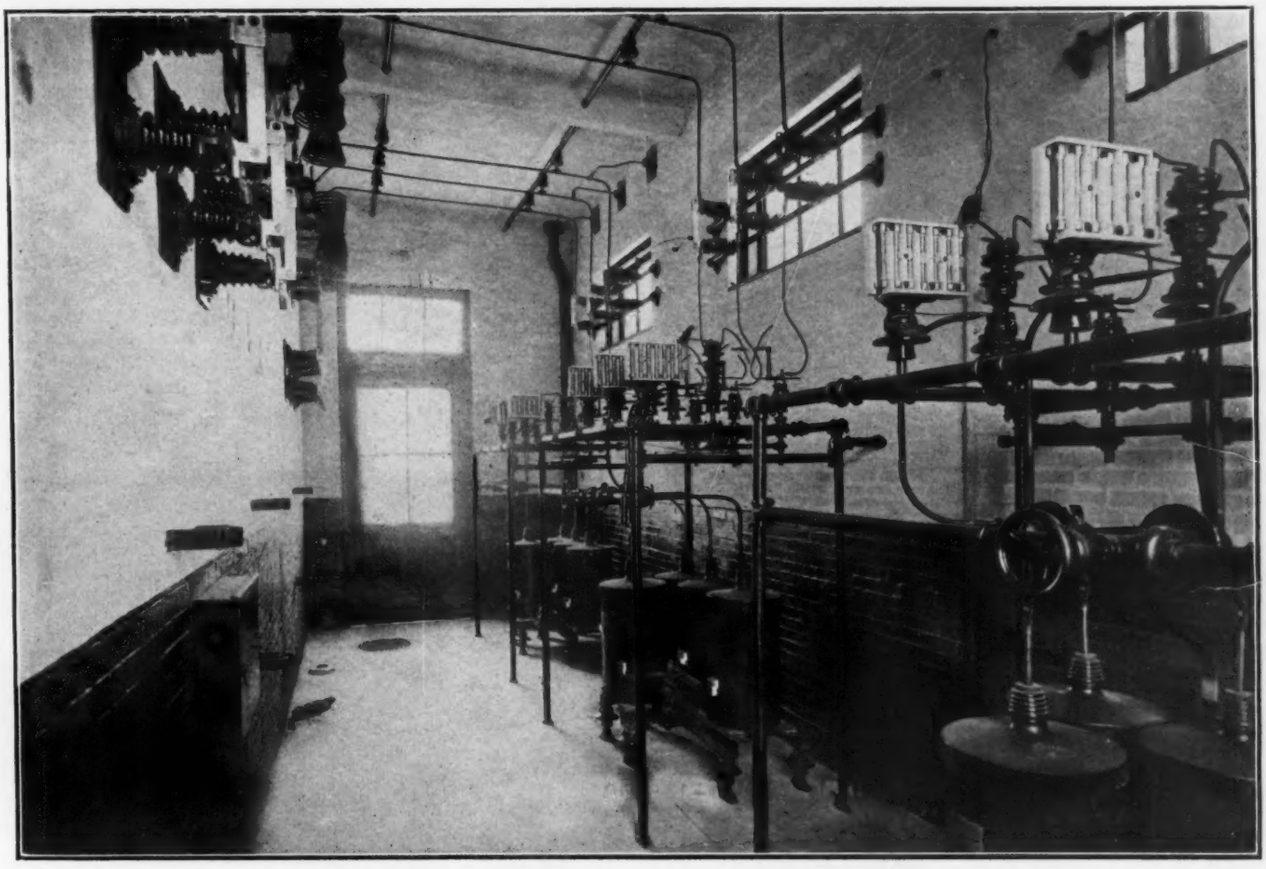


FIG. 21—INTERIOR OF HAMILTON ARRESTER HOUSE FOR BURLINGTON LINE

While the switchroom is shut off and away from the main generator room, the switchboard operator can command an unobstructed view of the latter by descending a short flight of stairs to the inspection gallery. This gallery is useful for visual observations in connection with testing, etc., in addition to the complete and effective signal systems installed between the switchroom and operating floor.

The principle of tying two single-phase induction-motor rotors together, the motors meanwhile having their fields excited, is utilized in the signaling system provided for the Keokuk plant. The scheme is one that has been employed for a variety of purposes at Panama, the place for which it has been especially developed by the manufacturer. Any motion of one rotor effects a corresponding movement of the distant indicator. The system is positive and requires only a single circuit for its operation. The signal pedestals in the generator room will be mounted near the governor

pedestals, bringing both under the hand of the floor attendant.

On receiving a signal, the attendant will reply, confirming the indication, over an entirely separate circuit, in this way insuring that the order is correctly received and understood. Later a time-recording element is to be added, giving a graphic record of the signals and the times of

FIG. 22—INSULATORS, 3000-FT. RIVER SPAN AT KEOKUK

starting and stopping the various units. The first position of the signal device is also to be arranged so that when "start" is shown a whistle will be blown calling the floor operator's attention, while at the same time a lamp will be lighted indicating the number of the unit that is to be started up.

In addition to these operating signals, nearly a hundred telephone instruments are scattered throughout the building, so that communication can be had with all important positions in the power house.

On panelboards at the rear of the operating benches are the usual banks, indicating instruments, ammeters, wattmeters, voltmeters, synchroscopes, etc. A duplicate bus diagram of the station connections is provided for the load dispatcher, who has a semicircular board at what will be the center of the completed room. A telephone switchboard on his desk enables him to communicate with any part of the system.

For operating the oil switches there are provided duplicate Exide 320-amp-hr. storage batteries, with E-9 plates in E-15 jars. These batteries, with their duplicate motor-driven charging sets, are located on the fourth floor adjoining the switchroom, which contains the battery switchboard.

Station Lighting and Auxiliaries

Special attention has been devoted to the illumination of the Keokuk power-house structure. Tungsten lamps are used throughout, and the station-lighting circuits are equipped with automatic induction regulators which maintain uniform voltage on the lamps.

In the generator room an intensity of 3.5 ft.-candles is provided at the floor level by 114 500-watt tungsten lamps in Holophane-D'Olier shades. In each of the thirty-eight 24-ft. bays there are three of these units, one at the center of the ceiling and two suspended on ornamental side brackets. Similar illumination is provided in the gate-house and in the apparatus compartments on the first and other floors.

The switchroom is furnished with diffused illumination by a skylight which forms the whole ceiling. At night the natural lighting is replaced by tungsten lamps behind these skylight panels, affording the same diffused quality of illumination.

At all points throughout the station where hand-lamp extensions are likely to prove useful for examining machinery push-type plug-in outlets have been liberally provided.

Emergency lighting of the building in case of plant shutdown is provided for by automatic switches which, upon failure of the bus pressure or over-voltage, connect batteries to selected circuits which feed about one-third of the lamps in the building. These lamps are so distributed that light will be available all throughout the structure. In this way the emergency lamps can be operated for an hour or more while carried by the storage batteries. Separate switchboards controlling the station lighting and power circuits are located on the generator-room gallery.

More than 1500 three-pane window sashes, which make up the movable sections of the 120 power-house windows, are motor-operated through Lupton window gear. From central control points all the windows in the structure can then be closed quickly on the sudden approach of a rainstorm, a feature which is of importance in the case of a great building like the Keokuk power plant, housing equipment that might be damaged by a wetting.

For handling the huge parts of the waterwheel and generator equipment two 150-ton Alliance traveling cranes serve the generator room from overhead runways which extend the length of the building. There are also passenger and freight elevators for reaching the upper floors on which the electrical equipment is located.

Imported red Welsh quarry tile, set on a cement founda-

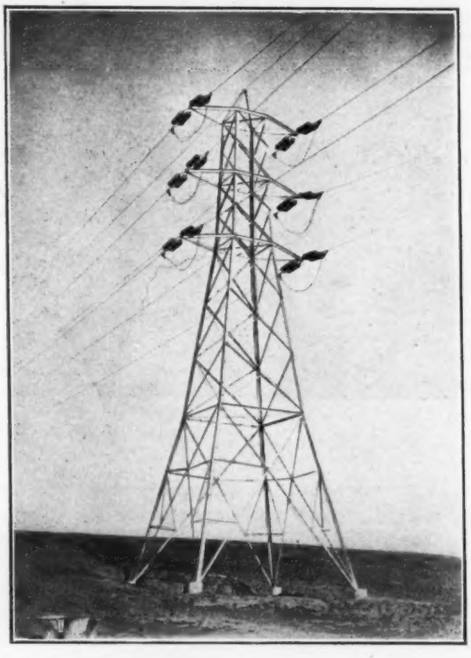


FIG. 23—ANCHOR TOWER WITH STRAND INSULATORS

tion, is used for the station flooring. The interior walls are tinted a light cream color, with olive-green base strips. The steel trusses supporting the roof have a similar green color, presenting an attractive trimmed appearance. Outside, the concrete walls of the building have been coated a pure white by treating the whole exterior with a wash of Lafarge cement, sand and water. Architecturally the lines

of the power-house structure are simple and harmonious, and the picture presented by the whole development is one of considerable beauty.

Modern locker rooms and toilet facilities are provided for employees at a number of points throughout the station.

110,000-Volt Transmission Line to St. Louis

From Keokuk to St. Louis, a distance of 144 miles, extends the main 110,000-volt transmission line, consisting of twin circuits carried in parallel vertical planes on a single set of towers. The conductors are 300,000 circ. mil in cross-section, by far the heaviest ever used for 110,000-volt construction. Each cable consists of nineteen strands of hard-drawn copper, the diameter of the whole being 0.625 in. The ultimate strength of this cable is 14,000 lb., giving a wide safety factor even under such extreme conditions as a half-inch ice coating in a 60-mile wind at 0 deg. Fahr. Under such conditions a loading of not over 7000 lb. is estimated for the 800-ft. standard spans employed on the line. The corona point for these 300,000-circ. mil conductors is 148,000 volts, which is nearly 35 per cent above the operating potential.

The steel towers for the St. Louis line are of the Riter-Conley type and on straight sections measure 79 ft. in height and 20 ft. by 20 ft. at the base. Each tower weighs 3.4 tons. The cables are carried on suspension insulators, each circuit being in a vertical plane on its side of the tower. These suspension insulators, manufactured by the Ohio Brass Company, are each made up of seven 10-in. disks, the "strings" measuring over all nearly 4 ft. in length. They have been subjected to dry tests of 440,000 volts and wet tests of 330,000 volts. The standard towers used with the freely suspended type of construction on tangent stretches are designed to support the weight and side strain of all conductors under the most extreme weather conditions, in addition to the unbalanced pull which may be exerted by two broken conductors.

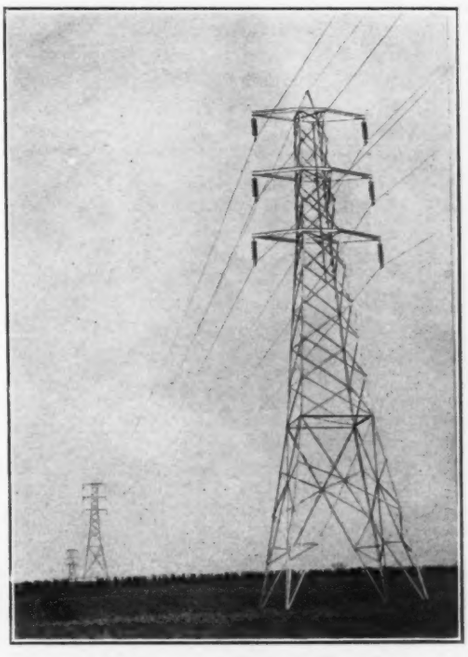


FIG. 24—LINE TOWER WITH SUSPENSION INSULATORS

Each leg of these towers is bolted to a reinforced-concrete foundation weighing 2 tons. These foundations extend 6 ft. below ground. In the marshes and lowlands which the line traverses the foundation legs are carried up to the level of the high-water mark. The towers were raised into position with the aid of an A-frame, an ingenious hinge socket being employed, fixed to the foundation. The hinge could then be lifted out of the way and the tower seated directly in its proper place on the concrete legs. Spans are pulled up by dynamometer tension.

At ten-tower intervals in the straight-line construction, as well as at angles, at railway crossings and wherever the lines are dead-ended, anchor towers of a heavier construction than the standard structures are employed. These

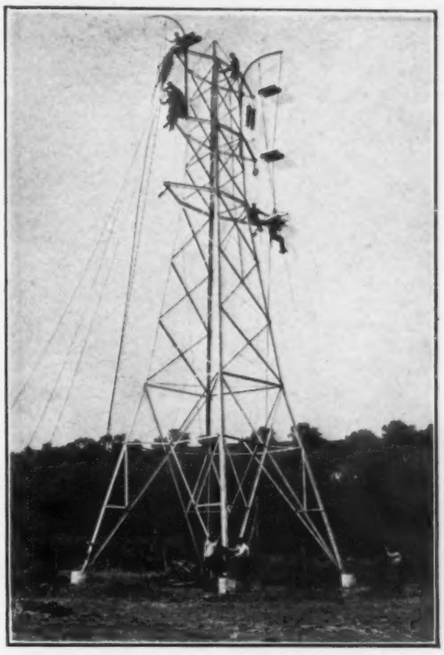


FIG. 25—DEAD-ENDING ON ANCHOR TOWER

anchor towers are 74 ft. high and have bases 24 ft. by 24 ft. Each tower weighs approximately 5 tons and is set on four concrete foundation legs extending 8 ft. below ground and each leg weighing 7.5 tons. The dead-end side pull for which these towers are designed totals 50,000 lb.

In addition to the six main conductors, which are supported at 10-ft. intervals at the sides of the towers, a ground wire of 0.5-in. galvanized Siemens-Martin steel is carried on the peaks of the structures. This ground conductor has an ultimate strength of 11,000 lb., although under the most severe weather conditions its possible tension will not exceed 5500 lb.

On account of the great weight of the 300,000-circ. mil line conductors, it was found necessary to design special clamp fittings to prevent crushing of the separate strands. The open-hearth steel clamp devised has a waved groove which introduces friction to prevent the cable from slipping. The ends of the clamp are also flared to avoid nicking of the conductor strands. At anchor towers all the conductors are dead-ended through eight-disk strings of insulators, while a jumper depending below the arm makes connection to the adjoining dead-end on the other side.

River Spans and Railroad Crossings

Leaving the power house by a 2800-ft. span across the Mississippi River, the line strikes out through Illinois, in which State the principal part of the 144-mile distance is covered. Later it again crosses the Mississippi and also the Missouri River before entering St. Louis. The private right-of-way traversed is 100 ft. wide, leaving space for a second transmission line if desired later. The title to this right-of-way is practically all owned by the Mississippi River Power Company.

For the 2800-ft. span across the Mississippi River at the power house the high-tension roof structure on the latter serves as one support, the Illinois end being carried from a pair of 135-ft. strain towers foundationed on concrete bases.

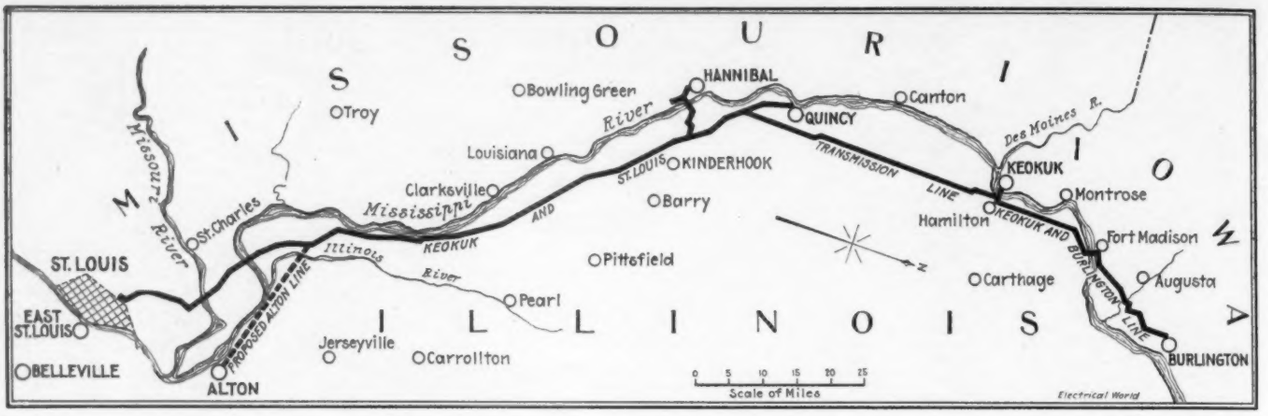


FIG. 26—MAP OF KEOKUK-ST. LOUIS TRANSMISSION LINE

The conductor used for these long river spans consists of a 0.625-in. core of special high-tension steel, with an outer stranding of twenty copper wires, making a total diameter of 0.875 in. For the river spans the conductors are mounted in a horizontal plane at 20-ft. distances, to avoid danger of swinging together during winds. Each span conductor is held by a bank of six paralled strings of insulators, an ingenious system of equalizing levers imposing the same strain on each insulator unit. The ultimate strength of the span conductors is 52,000 lb. and of the insulator groups 60,000 lb., although under the worst weather conditions the strains imposed will not exceed 24,000 lb.

Above the conductor spans are hung ground wires of 5/8-in. steel, one ground wire to each circuit. These ground cables support the telephone line wires on bracket hangers and also serve as runways for the cable cars used to inspect and repair the crossing spans.

Similar separate-tower span construction is employed at the other river crossings, in one instance towers 231 ft. in height being required. These towers, however, are not of the strain type, but are intermediate towers.

At railroad crossings the National Electric Light Association's recommendations are followed. Three short spans are built, one on each side of the crossing span, the outer towers being anchor structures. Conductors are dead-ended at all towers and strung at half normal tension on all three spans, so that possibility of a fallen line is very remote.

Paralleling the transmission line throughout the entire distance from Keokuk to St. Louis is a No. 8 telephone circuit carried on 30-ft. cedar poles, located on the edge of the right-of-way. This circuit is protected against lightning and transmission-line induction disturbances by a ground wire. At 4-mile intervals telephone booths are provided and patrolmen's houses are located 18 miles apart. Extra precautions have been taken to insulate the telephone lines.

USE OF MISSISSIPPI RIVER ENERGY

The Keokuk plant and transmission lines are to be operated, under the supervision of the Stone & Webster Management Association, by the Mississippi River Power Company, which sells energy directly to local distributing companies and to wholesale customers. The principal block of power at present generated at Keokuk will, of course, be transmitted to St. Louis under the 66,000-hp contract entered into with the Mississippi River Power Distributing Company.

From a transformer substation at Meppen several thousand kilowatts of 66,000-volt energy will be transmitted to Alton, Ill. At Hull 10,000 hp is to be taken by the Atlas Portland Cement Company. A contract has also been closed with the Central Illinois Public Service Company for feeding 2000 kw into its interconnected system in the west-central section of the State.

From Keokuk an 11,000-volt line is carried up the Illinois bank of the river to Burlington and Fort Madison, Ia. The Keokuk Electric Company, also a Stone & Webster corporation, operates electric lighting and railway properties in Keokuk and adjacent communities.

Other communities which will use Mississippi River energy are West Burlington, Hamilton, Wausau, Nauvoo, Dallas City, Quincy, Marblehead and Hull.

All work in connection with the Keokuk development of the Mississippi River Power Company has been carried out by administration, none of it having been executed by contract.

Mr. Hugh L. Cooper, vice-president and chief engineer of the company, has had general charge of all hydraulic design and construction in connection with the dam, power house and navigation works. The station superstructure, electrical equipment, transmission lines, etc., were designed and constructed by the Stone & Webster Engineering Corporation, Boston, Mass.

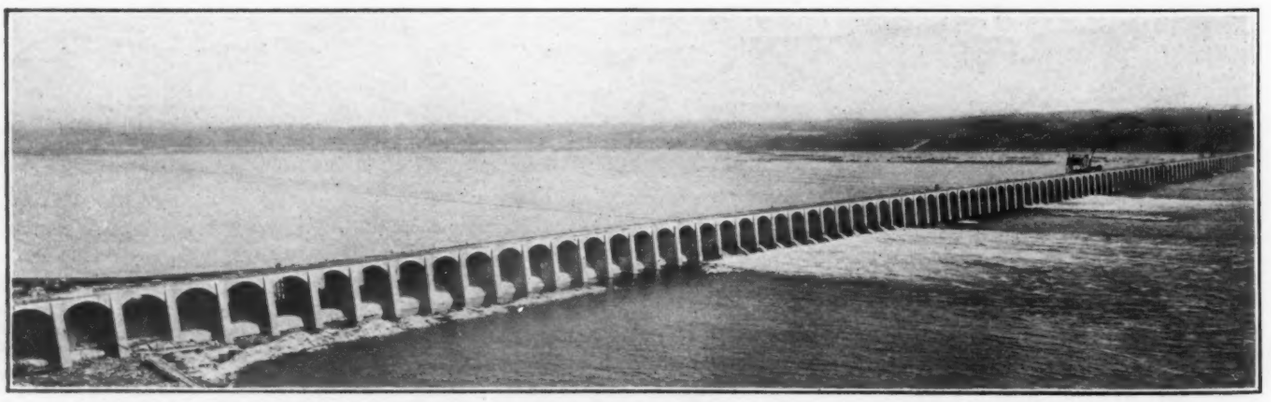


FIG .27—THE MONOLITHIC CONCRETE DAM, 4278 FT. LONG

Receiving Substation at St. Louis

60,000-kw transforming and distributing equipment to receive 100,000-volt hydroelectric energy from Keokuk—The largest substation in existence

THE 60,000-kw receiving substation in the western suburbs of St. Louis which will supply Keokuk hydroelectric energy to the Union Electric Light & Power Company and the United Railways Company of St. Louis has the distinction of being the largest substation in the world.

The building is a brick structure with white terra-cotta trimmings and is fireproof throughout. In plan its shape is that of a T, it being 218 ft. 9 in. long, 63 ft. high and 150 ft. 7 in. wide at its widest section. All of the high-tension equipment is installed in the stem of the T, while the apparatus used by the Union Electric Light & Power Company and the United Railways Company of St. Louis is located in the transept. Since the contracts with the local companies specify power supply from separate buses, the substation has been divided into four high-tension units, each consisting of three 5000-kw, 110,000/13,200-volt General Electric transformers, which can be operated separately or together. Thus each company can obtain service over both transmission lines. Either line is sufficient, however, to take care of the maximum load, 66,000 hp, so that no interruption to service will result when it is desired to make line repairs.

FIG. 1—RECEIVING SUBSTATION AT ST. LOUIS

A steel frame erected on the roof of the substation supports the entering high-tension wires, which are thence led to the insulated roof bushings. These bushings are the outdoor type and are set in a vertical position in the concrete roof. On the roof will also be installed four General Electric motor-operated air-break disconnecting switches. When these switches are open all of the electrical apparatus inside of the building is, of course, de-energized. The horn-gaps for the lightning arresters are also on the roof.

Interior High-Tension Arrangement

In the high-tension portion of the substation is a gallery on which four groups of oil switches are installed. Each group, making up one triple-pole switch, consists of three oil switches which are situated between the incoming 110,000-volt lines and the high-tension buses. A specially designed system of selective relays will operate these line switches in the event of any trouble on the respective lines. The busbars consist of 1-in. copper tubing supported from the roof trusses by suspension-type insulators similar to those used on the transmission line. The high-tension bus is divided into four sections by three oil switches, an arrangement which permits fulfilling the terms of the contract previously mentioned.

On the ground floor are seven groups of three General Electric single-pole oil switches, four of which are transformer switches, while the remaining three groups are the bus switches. All of the high-tension oil switches are rated at 300 amp and are inclosed in cast-iron cases. The switches are designed to open by gravity and are closed by individual solenoids remotely controlled from a 110-volt storage battery.

Above each of the seven oil switches on the main floor are erected steel frames on which disconnecting switches of local special design are mounted. These disconnecting switches (which will be used for isolating the transformer and bus oil switches from the high-tension buses when it is desired to repair them) consist of switch rods sliding vertically and engaging cone slips in the closed position, in which they can be firmly locked by means of bayonet joints.

Transformer Room

Opening off from the west side of the high-tension room are four compartments in which are the transformer units. Each compartment contains three 5000-kw, 95,000/13,800-volt water-cooled General Electric transformers. Each transformer tank holds about 5000 gal. of oil and weighs 114,000 lb. when ready for operation. The cores alone weigh 30 tons apiece. The transformers will be connected delta delta.

The transformers are set on trucks which can be run out of the building onto a track by raising a roll steel curtain on the west wall of each compartment. The transformer may then be conveyed along this track to a crane located in the south end of the substation, in case it is desired to remove the core for inspection or repairs. The pipes for circulating water to the transformer cooling coils run along the wall inside the switch room before going to the transformers, so the valves are within easy reach of the station attendant. Four large storage tanks for transformer oil are placed in the basement below each transformer compartment. This oil can be treated by the station filter press at the rate of about 600 gal. per hour.

The low-tension leads of the instrument transformers which are located in the bus structure are carried beneath the floor to terminal boards located on the main floor of the high-tension switchroom just beneath the gallery. Curve-tracing apparatus and integrating meters will be mounted on these boards instead of on the main switch-

board. Conduit has been laid in the concrete floor connecting all of the terminal boards, so that if it is desired at any time to record the output of one board on the meters of another board the connections can be quickly made.

Four sets of aluminum-cell lightning arresters are to be installed in the gallery of the high-tension room, one set being connected to each 100,000-volt unit. These arresters are of the grounded-tank type.

Low-Tension Oil Switches

The low-tension oil switches, which are of the General Electric H-6 type, are under the gallery on the main floors. The 13,200-volt leads from the transformers are carried on insulated racks beneath the floor to the low-tension transformer switches. Four bus switches are connected on the low-tension side of the transformers. Additional oil switches are connected between the busbars and the four distributing panels. Each distributing panel has five circuits, some of which will be conducted away from the substation through underground cable to substations in the surrounding territory, while others will be carried on overhead lines. Part of the energy will be transformed to a lower voltage or to direct current before it leaves the station.

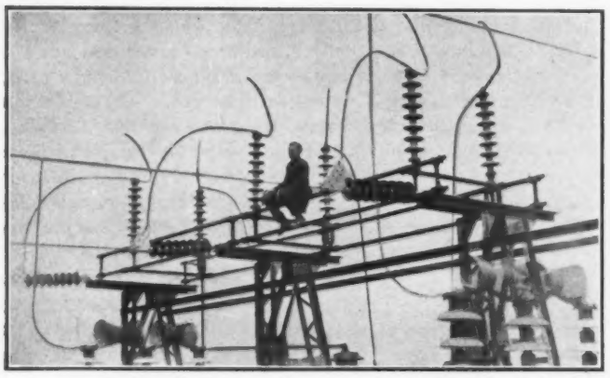


FIG. 2—HORN-GAPS FOR LIGHTNING-ARRESTER EQUIPMENT

Along the north side of the portion of the building occupied by the railway and lighting companies a switch gallery has been erected. From this gallery the switch operator has an unobstructed view of the high-tension room, as well as the low-tension room. Benchboards are used exclusively for the operation of all the switches.

Electrical Machinery

On the main floor of the south portion of the building will be placed the electrical apparatus used by the railway company and the lighting company for converting the 25-cycle energy into the form desired for use. Two 2000-kw, 375/600-volt rotary converters, with the necessary air-blast transformers for stepping the pressure down from 13,200 volts to 375 volts, will be installed by the United Railways Company, with space for two more units.

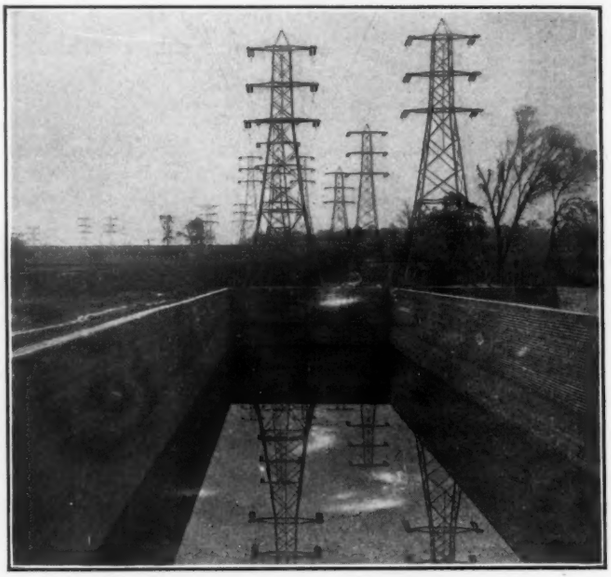


FIG. 4—TRANSFORMER COOLING-WATER BASINS

The Union Electric Light & Power Company will install one 5000-kw, 25/60-cycle frequency-changer set for the present, while another may be installed later. To be operated in conjunction with these frequency changers, a group of 13,200/4400-volt, 60-cycle transformers with an aggregate rating of 9000 kw will also be installed. The storage battery for operating the oil switches and supervising lamps will be situated on a gallery just under the roof.

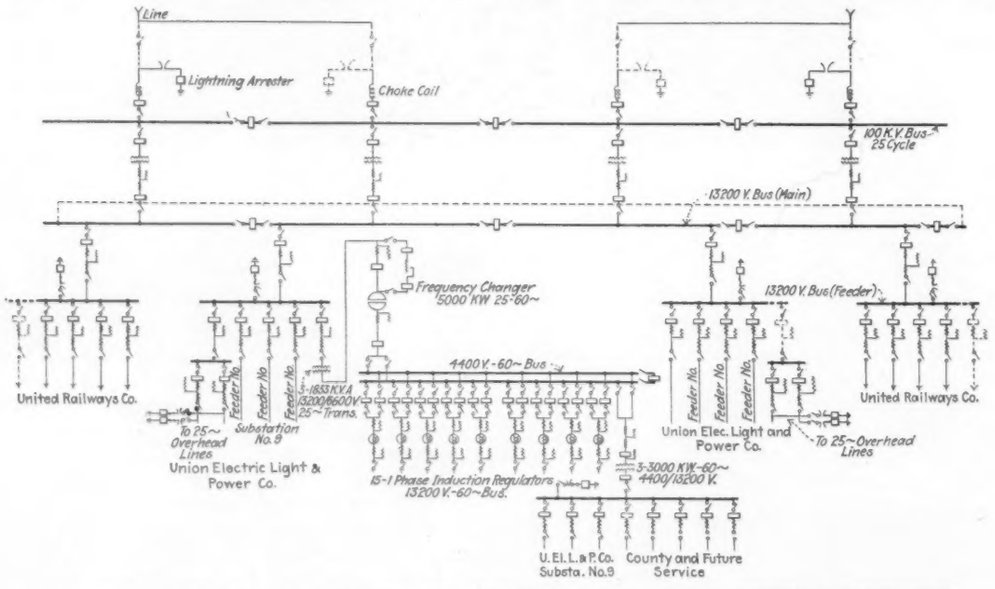


FIG. 3—ARRANGEMENT OF CIRCUITS AND APPARATUS IN ST. LOUIS RECEIVING SUBSTATION

The St. Louis substation has been constructed and will be operated by the Mississippi River Power Distributing Company, of which Mr. C. S. Ruffner is general manager.

Central Station Management

Devoted to Discussion of Administrative Policies, Commercial Methods, and Current Practice Among Successful Utilities

Campaign Among Chinese Laundrymen in Toronto

There are about 200 Chinese laundries in the city of Toronto, Ont., most of which are lighted by electricity. In order to bring home to the Mongolians all the advantages of electricity, especially its particular application to their trade, the Toronto Electric Light Company, Ltd., has engaged a Chinese solicitor with a wide acquaintance among

CIRCULAR DISTRIBUTED AMONG CHINESE LAUNDRYMEN IN TORONTO, ONT.

his countrymen to start an electric-iron campaign. The solicitor is equipped with a sample demonstrating iron and copies of the circular reproduced herewith. On this are given in Chinese characters full directions for the proper use of the electric iron, together with a number of "don'ts," the latter being almost as important as the former. Although Chinese campaigns have been carried out in Brooklyn and other cities, Toronto is probably the first city in which the flatiron campaign has been undertaken with such attention to linguistic detail.

Mail-Order Toaster-Stove Campaign in Brooklyn

Taking advantage of a reduced price offered by the manufacturer of an electric toaster stove, effective for one day only, the Edison Electric Illuminating Company of Brooklyn inaugurated a mail-order campaign to residence customers only, offering a toaster stove on May 10 at half price. A self-addressed post card, one-quarter of which is

El Tostovo is a thoroughly practical and effective toaster stove. It will toast, cook meat, fish and vegetables, shirr eggs, scramble or fry them, or in fact do anything required of the ordinary electric stove, and more.

Made of pressed steel, nickel plated to a brilliant polish, with ebonite handle.

The price of El Tostovo will be $4.00, but in order to give it a wide and thorough introduction we will sell it for ONE DAY ONLY, SATURDAY, MAY 10th, AT HALF PRICE—$2.00. Monday, May 12th, and thereafter, the price will be $4.00

We have no idea how many of our customers will want to order El Tostovo, and in order to place our order with the manufacturer intelligently and have a sufficient number to meet the demand, we would respectfully request, if you are interested in this attractive offer, that you fill out and mail to us the annexed postal. We will then reserve El Tostovo for delivery to you on the 10th day of May.

We would be glad to hear from you concerning this new appliance as soon as possible.

PORTION OF POST CARD USED IN MAIL-ORDER CAMPAIGN IN BROOKLYN

shown herewith, was sent with the regular monthly bills to residence customers, and so well was the proposition received that on the day mentioned no less than 750 stoves were disposed of. The sales expense, exclusive of delivery by the company's electric wagons, was only $52. The whole story is told on the portion of the card shown, and the result of the campaign was very gratifying to the company and has brought in considerable new business.

Lighting Company's Duty to Trespassers

B. B. Paton, a lineman in the employ of the Southwestern Telegraph & Telephone Company, was injured by coming in contact with a live wire while doing some repair work for his company on one of the poles carrying the lines of the Denison Light & Power Company. Suit was brought by him against both companies for damages to cover the injuries received. A verdict of the lower court for the plaintiff was reversed in the Supreme Court of Texas (154 S. W., 540). In delivering his opinion Judge Phillips said: (1) Negligence is constituted only through failure to discharge a duty. (2) Where an employee of a telephone company, in order to repair its wires, went onto a pole belonging to the lighting company, he was a mere licensee, and the lighting company did not owe him the duty of ordinary care. (3) The owner of premises is under no general duty to make them safe for others coming thereon without authority, invitation or allurement. (4) A reason-

able belief on the part of the chief lineman of the lighting company that the plaintiff was at work on the pole was not sufficient to charge that company with the duty of exercising care to make its property safe for that work.

Block-Lighting Plant Absorbed in St. Louis

The Union Electric Light & Power Company, of St. Louis, has taken over the block-lighting plant in the basement of the Central National Bank Building heretofore operated by the Neighborhood Power, Light & Heat Company, of which Mr. Joseph E. Martin is president. This plant has provided electricity and heat for the buildings in the block bounded by Olive, Locust, Seventh and Eighth Streets. The Neighborhood company is owned by the owners of the Central National Bank Building and the Chemical Building. It has leased its premises and plant to the Union Electric Company at a rental of about $5,000 a year. It is reported that the central-station company will shut down the existing plant during each summer and operate it only in winter to supply steam for heating. The Neighborhood company's installation is one of the largest isolated plants in St. Louis. The Union Electric company is soon to be supplied with hydroelectric energy from the Keokuk development on the Mississippi River and is enabled to make attractive prices in supplying electricity.

Counter Refrigeration an Attractive Central-Station Load

Counter refrigeration in grocery stores and butcher shops should furnish a very attractive central-station load, as it requires energy during the whole day. Electrically operated refrigerating systems for display counters have given considerable satisfaction to dealers in meats and fresh vegetables in St. Louis. The accompanying illustrations show the electrically operated refrigerating machine in the basement and one of the main meat-display counters of the H. G. Hill Grocery Company of St. Louis. Cut meats are

FIG. 1—MEAT-DISPLAY COUNTER

displayed in a glass case 70 ft. long which is cooled by coils along the back. The counters are partly open at the top and back so as to allow access to the cases without the necessity of operating a slide door. Blocks of butter of such weight as are usually sold to the average retail trade are kept in a counter 25 ft. long, constructed similarly to the foregoing. For the storage of uncut fresh meats, smoked meats and sausage a wall display case made in sections 40 ft. and 25 ft. long respectively is used. In addition to the butter-display counter, a 30-ft. roll-top butter-refrigerating cabinet is installed.

On the second floor are a cooling room 10 ft. wide by 14 ft. long and an adjoining anteroom 10 ft. wide by 20 ft. long. In the latter room meat is cut up each day and sent

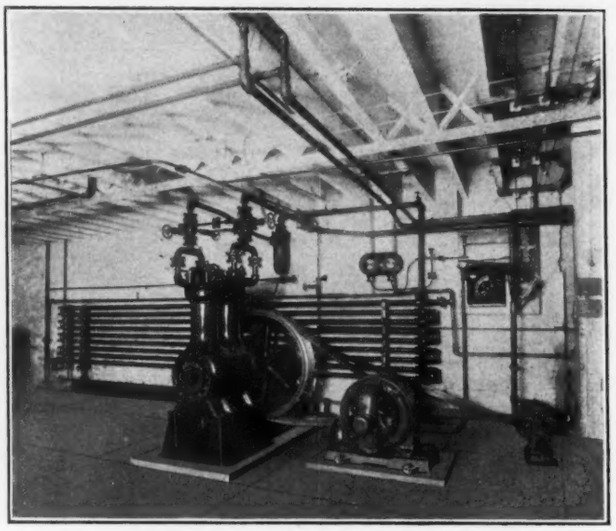


FIG. 2—REFRIGERATING PLANT IN BASEMENT

down to the display counters, where it is stored until sold. By this arrangement the usual delay encountered in butcher shops during rush hours, incident to the cutting of meat after it is selected, is avoided. At the same time the discoloration of cut meat is eliminated by putting it directly into a cold place. The manager of this store has noticed that no trouble has been experienced from flies gathering on the meat, as the cold air surrounding the coils is not comfortable for the flies.

The general cold-storage room, which is 10 ft. wide and 50 ft. long, is located in the basement, as is also the refrigerating machinery. A 25-hp motor shown in the illustration drives a 10-ton Brecht compressor and a small brine circulating pump through belts. Electricity for operating the motor is furnished by the Union Electric Light & Power Company of St. Louis.

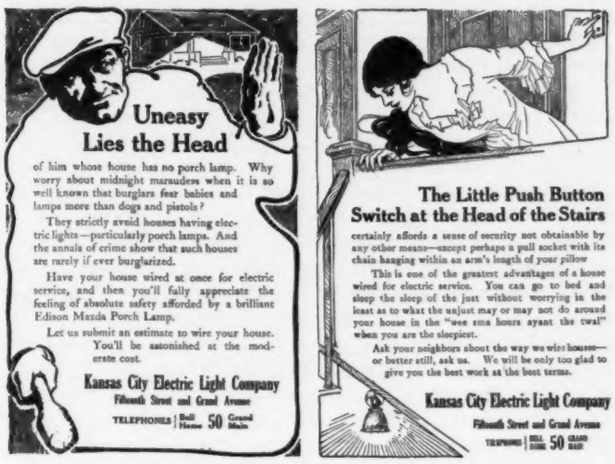
The cooling room on the second floor contains seventeen 6-in. brine pipes, 10.5 ft. long, and two 5-in. double-pipe brine coolers hung from the ceiling. In the cold-storage room in the basement, which consists of two compartments, are twenty-four 6-in. brine pipes 8 ft. long. Each of the wallcases on the main floor contains six 6-in. brine pipes which run the full length of the cases. All of the display cases are equipped with direct-expansion pipes.

"Electricity in the Home"

The Commonwealth Edison Company of Chicago has issued a handsome booklet bearing the title "Electricity in the Home." The pamphlet contains numerous illustrations in color and shows applications of electricity in the living room, reception hall, bathroom, boudoir, dining room, library, porch, kitchen, laundry and other rooms in a modern residence. The book is distributed among the residence "prospects" and contains a good deal of useful information—just the sort that up-to-date home-makers are anxious to obtain. Mr. O. R. Hogue, special agent of the contract department of the company, is largely responsible for the material in the booklet, while Mr. D. H. Howard, advertising manager, is entitled to credit for its handsome appearance.

Timeliness in Advertising

Timely methods of advertising electric service were employed effectively by the Kansas City Electric Light Company of Kansas City, Mo., after a recent murder which gained much publicity in the newspapers of that city. A woman was called to the front door of her house one night by someone ringing the doorbell. Coming from a well-


Uneasy
Lies the Head
of him whose house has no porch lamp. Why worry about midnight marauders when it is so well known that burglars fear babies and lamps more than dogs and pistols?
They strictly avoid houses having electric lights—particularly porch lamps. And the annals of crime show that such houses are rarely if ever burglarized.
Have your house wired at once for electric service, and then you'll fully appreciate the feeling of absolute safety afforded by a brilliant Edison Mazda Porch Lamp.
Let us submit an estimate to wire your house. You'll be astonished at the moderate cost.
Kansas City Electric Light Company
Fifteenth Street and Grand Avenue
TELEPHONES Bell Home 50 Grand Main
The Little Push Button
Switch at the Head of the Stairs
certainly affords a sense of security not obtainable by any other means—except perhaps a pull socket with its chain hanging within an arm's length of your pillow
This is one of the greatest advantages of a house wired for electric service. You can go to bed and sleep the sleep of the just without worrying in the least as to what the unjust may or may not do around your house in the "wee sma hours ayant the twa!" when you are the sleepiest.
Ask your neighbors about the way we wire houses—or better still, ask us. We will be only too glad to give you the best work at the best terms.
Kansas City Electric Light Company
Fifteenth Street and Grand Avenue
TELEPHONES Bell Home 50 Grand Main

ADVERTISEMENTS USED IN KANSAS CITY, MO.

lighted room to a dark porch, she was unable to see the caller, who attacked her so savagely that her death resulted. Several illustrated cards explaining the advantages of porch and hall lamps similar to those reproduced herewith were mailed to the residents in the city at regular intervals thereafter. An increase in requests for electric service was attributed to this scheme of advertising.

Electric Cooking at Boston Engineers' Club

With the opening of the building of the Engineers' Club of Boston about three months ago electric cooking was inaugurated on the premises in the face of conditions which were of unusual difficulty in comparison with the problem of successful electric-range service in residential and institutional fields. Large electric ranges have been used successfully for a number of years past in installations where routine work or the opportunity to shut off the use of energy for long periods favored the most economical operation; but until this application was made the opinion was widely held that club cooking was pre-eminently the province of the gas, coal or charcoal-burning equipment so long standardized for hotel and restaurant service. Electricity was selected as the means of cooking after a thorough investigation of the possibilities of such service by a committee of engineers appointed on account of their technical qualifications to make a careful study of the subject, and in the face of considerable rivalry on the part of advocates of gas-range service. At present no figures are available for publication as to the cost of the service, but it has been highly successful from the outset and has been closely studied on its economic side. The results of the work so far indicate that the committee decided wisely in selecting electric cooking for this important and interesting installation.

From the opening day at the club's home practically all the cooking in the establishment has been done by electricity, the only exceptions being the boiling of soup stock and a part of the cooking of vegetables, which is done by steam. But a considerable share even of this work is performed by electricity when the chef's convenience is best served by this method. In most clubs it is customary to purchase pastry, bread, rolls and cake from outside bakers, but in the case of the Engineers' Club all this material is prepared and baked on the premises in an electric oven. The roasting, frying, broiling, griddling and boiling required in the kitchen service are handled on a large electric range shown in Fig. 1; the bread and pastry are baked in the oven shown in Fig. 2.

The problem of the Engineers' Club kitchen is rendered specially difficult by the need of being able to serve any item on the menu, singly or in quantities, at any time between 7 a. m. and 1 a. m. The club membership is about 600, and the average number of meals served at the house in February, 1913, was 240 per day. On some days over 300 meals are served, and more than 500 meals per day can be served if necessary. The officers of the Edison Electric Illuminating Company of Boston, which supplies the energy, are closely identified with the club, and under their direction careful records are being made of the energy consumption and the demand of the installation, with the accumulation of other data which will be helpful in the extension of electric heating and cooking service under the company's new miscellaneous energy rates. The service is more difficult than hotel or residential work on account of the standby demand for energy to meet widely fluctuating calls for the products of the kitchen throughout the range of hours above mentioned. It is perhaps as unfavorable to the best economy of electric cooking as any which could be cited, and its use in the club in successful competition with coal, gas and charcoal marks a distinct advance in the application of electricity to the commercial heating field.

Both the range and the baking oven, which were built by the Simplex Electric Heating Company, Cambridge, Mass., are located on the top floor of the club house and are supplied with direct-current energy from the underground Edison 110-220-volt, three-wire mains. The apparatus could be used equally well on alternating-current circuits. The range is 12 ft. long, 4.5 ft. high and has a maximum depth of 3 ft. It is of steel and Russia iron throughout, with polished trimmings, and contains three baking and roasting ovens with an inside working space of 21.5 in. by 27 in. by 14 in. in each; one 24-in. by 18-in. electric broiler in two sections; two deep-fat frying kettles, each 12 in. in diameter; one 12-in. by 18-in. flat griddle; one 12-in. by 18-in. frying pan for service not requiring deep fat; a three-section waffle-iron and eight disk heaters from 6 in

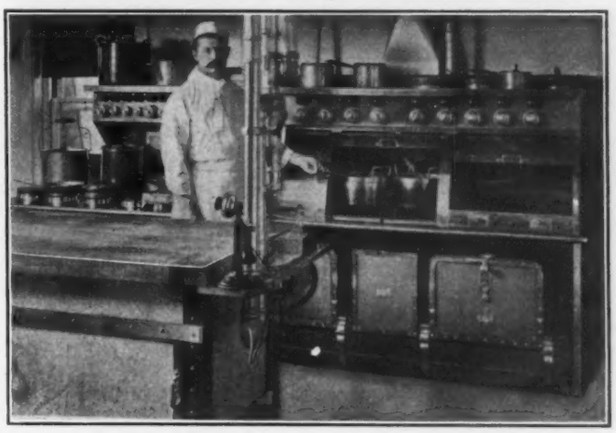


FIG. 1—ELECTRIC RANGE IN ENGINEERS' CLUB, BOSTON

to 12 in. in diameter, the latter being used in connection with special copper utensils for boiling, stewing and cooking individual orders of various kinds. On the range are twenty-one circuits, each of which is controlled by an indicating snap switch mounted on a panel at the top and about 24 in. above the range surface, the latter being 30 in. above the floor. Three extra outlets are provided for con-

necting special portable heaters at any time, and all the circuits are provided with ruby-colored tungsten pilot lamps, one in series with each switch and showing by the degree of brightness the heat which is being utilized. Each oven and utensil on the range is designed for operation at high, low or medium heat, according to the position of the corresponding snap switch, and all switches show the degree of heating applied. The wattage varies from 50 to 75 per cent of the high-heat wattage for the various medium heats and from 20 to 33⅓ per cent of the high-heat wattage for the various low heats. No external resistance is required in the use of the range or any of its equipment. The pilot lamps are manufactured for 120-volt service, and as they are run far below their rated pressure they are giving excellent life records. Even at the high heat these lamps take only about 7 watts each.

Each of the ovens and each of the heaters on top of the range surface is controlled by its own independent switch. The broilers, frying kettles and griddles are inclosed in Russia iron cabinets on the working surface of the range, with sliding doors, two of which are shown partly open in the accompanying view, and which are designed to run back-

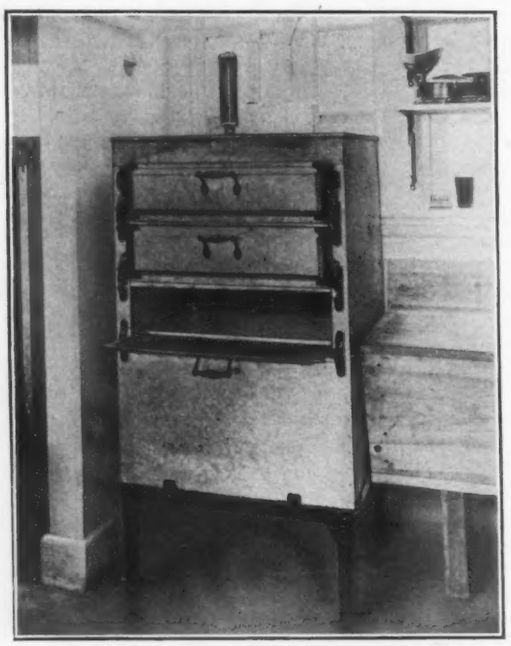


FIG. 2—ELECTRIC OVEN FOR BAKING BREAD AND PASTRY

ward and out of sight like the cover of a roll-top desk. These serve to protect the heaters from drafts, thus increasing the efficiency, and the arrangement also prevents the escape of odors from broiling or frying into the room. These cabinets are connected with a vent flue of sheet iron by which all odors are carried away from the kitchen. Above the cabinets and extending also to the left over the open part of the range is a shelf about 15 in. wide, which is used in holding utensils when not in service. A concealed distribution panel under the shelf, but readily accessible, carries a pair of fuses for each circuit on the range, and all wiring is installed in porcelain bushings.

The range is adapted for three-wire service, the mains being brought into the top in conduit. The utensils used on the disks at the left-hand end of the range are provided with a rim in each case which incloses the top of the heater, thus allowing no heat to escape through imperfect contact. A lock-on device is also provided, so that the utensil is drawn close against the heater by a slight turn of a handle. As the disks are inclosed on all sides, the loss of heat downward is prevented and practically all the heat generated is applied to the work of cooking.

All the oven walls are double and filled with insulating material. The ovens are backed against the wall of the kitchen, which has a wooden baseboard. At the request of the local insurance inspector a temperature test was made after one of the ovens had been run five or six hours empty at full heat, attaining an interior thermometric reading of over 600 deg. Fahr. The reading outside was taken at the hottest point behind the ovens, in the narrow and inclosed space near the wooden baseboard, and the temperature under the above conditions was only 160 deg. Fahr. All the oven cooking is on the closed method, and only the broilers, frying kettles and griddles are connected to the vent pipe.

The connected load of the range is about 30 kw, assuming all apparatus in service at the maximum heat, a condition which will probably never be encountered in practice. The eight disk heaters have a total maximum connected load of 6525 watts; the waffle-iron, cooking three at a time, 1150 watts; the two griddles, 3250 watts total; the three roasting ovens, 9900 watts total; the two frying kettles, 5000 watts total, and the broiler, 4400 watts.

The baker's oven (Fig. 2) is 58 in. high, 32 in. wide and 29 in. deep and is equipped with three 28-in. x 20-in. shelves, with a total capacity of thirty-six 1-lb. loaves. Three heats are provided, the maximum demand being 5000 watts, with about two-thirds the maximum on the medium heat and one-third the maximum on the low heat. The baking is uniform and no shifting of pans is required. The oven occupies less than 20 per cent of the space required for a brick oven of the same capacity and has very slight heat radiation, so that although it stands adjoining the ice chest, no trouble arises from this cause. Double walls are provided, the outside wall being of galvanized iron, with insulating material packed into the intermediate space. Separate drop-hinged doors are furnished for the shelves.

The heating of water for general kitchen service and for the boiling of soup stock at low temperatures is done by steam, a supply of which is always available on the premises. No provision is made for coal or gas cooking as none is required.

The curve-drawing instrumental records now being taken daily show a rapid increase in load between 5 a.m., when the oven is first cut into service, and 7 a.m., with a gradual increase in demand to a maximum occurring in the late forenoon, followed by a gradual decrease in demand throughout the afternoon and evening until the apparatus is cut out of service late at night. The greater part of the load is handled during the hours between 7 a.m. and 6 p.m. A table d'hôte luncheon and a dinner are served at the club in addition to the à la carte dishes. Since a party of twelve may arrive at midnight and order broiled live lobster, for example, it is the practice to hold the equipment ready for instant service, thereby enabling such an order to be filled without delay and more quickly than is practicable with coal or charcoal-burning equipment. This "readiness-to-serve" on the part of the equipment necessitates keeping part of the range alive for most of the day.

Creating Interest in the Electric Iron

In line with its progressive and energetic methods, the Public Service Electric Company, of Newark, N. J., is making a special bid for the installing of electric irons in the homes of its consumers. A well-prepared folder—"Iron in Cool Comfort"—is being sent out to prospective customers. In terse sentences it tells the reasons why the electric iron tends toward "cool comfort," and the company offers prospective users an opportunity to have an iron on free trial for two or three weeks. These irons are offered at $3.50 and $3.75 and may be paid for in monthly payments of $1 each. This price includes cord, plug and stand and a five-year guarantee of the iron.

Illumination and Wiring

Houses Wired by Dirtless Workmen

Quite frequently there is to be found a home in which great care has been taken in the selection of rugs, pictures and furniture but in which the lighting and lighting fixtures are inadequate, antiquated and totally out of harmony with their surroundings. It is certain that lighting fixtures are as much a part of the furnishings of a room as is the rug, the bookcase or the easy chair, and no room is well furnished in which the lighting equipment does not harmonize with its surroundings.

In many cases change is not made in the lighting system because the idea has become established in the minds of many people that any new installation involves an undue expense, necessitates tearing up floors, much after the fashion of the village volunteer fire department in search of a smoldering blaze, and means an era of disturbance and unrest within the household while the wiremen hold sway and scatter dirt and plaster upon the parquet floors and the best rugs in the house. Many timid folk mistakenly believe the electrician to be a half-brother to the plumber and the paper-hanger—a man with muddy boots, grimy hands and

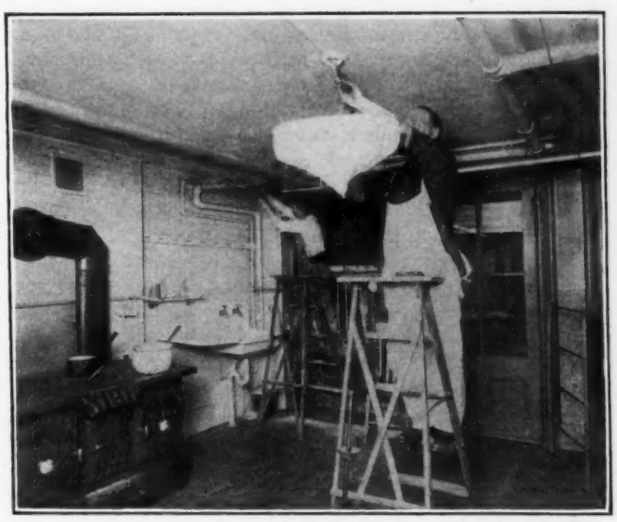


FIG. 1—DEVICE FOR CATCHING FALLING PLASTER

an anarchistic disregard for property. They picture him as one who leaves a trail of stained walls, marred woodwork and broken bric-à-brac in his wake. It must be admitted that this popular conception was at one time very true.

However, every science, every trade and every industry develops a new and different type of artisan and worker. While Luther Burbank, the wizard of plants, has been developing the seedless plum and the spineless cactus the electrical industry has not been idle. It has developed the dirtless workman. The absolute demand for wiremen who can equip a home for electric service without marring the walls, woodwork or furniture, without removing a single curtain from a doorway or a picture from the wall, has developed a class of workmen of unbounded skill and resourcefulness.

As an excellent example of the cleverness of these men attention is called to Fig. 1. This photograph shows a wireman in the act of cutting a small hole in the ceiling through which the circuit will be led to the kitchen fixture. Even a small hole, however, requires the removal of an amount of plaster which when once upon the floor seems to possess a faculty for spreading which is to be found in no other material. The wise electrician knows this, and in order that his own shoes may not be the means of carrying this plaster to other parts of the house he has devised the simple yet effective dust catcher which is shown in the illustration.

This device consists of an ordinary barrel-hoop covered with closely woven cloth to which are fastened four wires for holding the hoop in place. These wires are attached to the gas pipe at the outlet. When no pipe is available for holding the dust catcher a small nail driven into the ceiling

FIG. 2—FISHING CIRCUIT UNDER PARQUET FLOOR

at a point near the edge of the circle of plaster to be removed serves very well. With the dust catcher in place the wireman is free to work with both hands and is sure that there will be no criticism concerning particles of plaster on the floor beneath. Where the floor is covered with an expensive carpet or rug it is the practice to use an additional canvas beneath the ladder and to leave the canvas in place while the work of "fishing" and drawing in the steel conduit is being done. Some of the more careful contractors keep a boy at hand to clean up any dirt or plaster that may accidentally get beyond the edges of the protecting canvas.

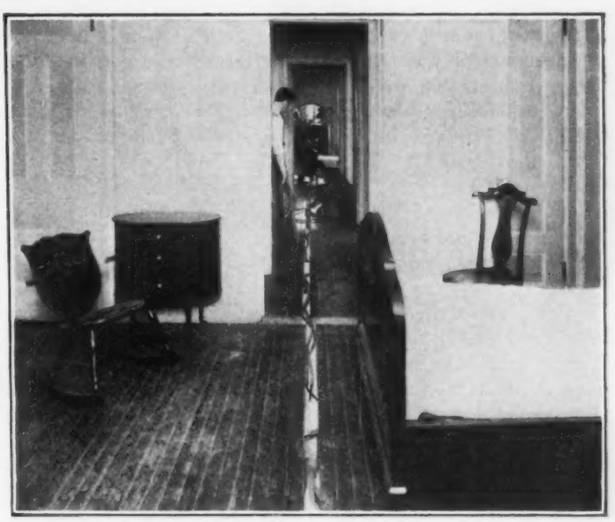


FIG. 3—LAYING CIRCUITS UNDER DOUBLE FLOOR

Fig. 2 shows how far wrong is the popular conception of the wireman's method of attacking a floor. Armed with a hammer, a special knife and a putty knife, the wireman has lifted three small pieces of the parquet flooring without injuring them and with a chisel and circle saw has cut a small square hole in the double pine flooring beneath. At the door he has removed the three pieces of flooring which

formed the doorsill and with the assistance of his helper has finished the circuit between these two points. With this accomplished the small boards are replaced as they were found. In one instance where a parquet floor of this kind had been taken up and relaid the householder upon his knees examined the relaid flooring indicated by the electrician as the portion which had been torn up and flatly

FIG. 4—WORKMAN CUTTING OPENING IN SIDE WALL FOR OUTLET BOX

refused to believe that the work had been done, so well had all traces been removed.

On another floor of the house shown in Fig. 1 and 2 a different type of double floor was encountered. The method used by the wiremen in laying their circuits in this case is illustrated in Fig. 3. A single board of the top layer of flooring was taken up the full length of the two rooms and hall to be wired. In the boards which made up the second layer of floor holes were made at regular intervals and the joists bored with a long bit which permitted boring two joists from one position if necessary. Replacing the hard-wood top flooring effectually removed all evidence of the wiring concealed beneath the floor. In this job there were about forty outlets, and the installation complete cost approximately $5 an outlet. This may be said to be an average price for wiring houses of this type; but it varies with the many conditions. Houses with carpeted floors as a rule are more expensive to wire than those with hard-wood floors and rugs, as the carpets must be taken up and relaid.

In the larger cities where the apartment dwellers are more or less nomadic, preferring to live in the suburbs during the summer and in city apartments in the winter, the landlord generally can take advantage of the tenants' absence to have the dwelling wired. However, it behooves him to be doubly sure that the work is done with extreme care in such cases, as the average tenant is always ready to complain of dirt or disorder occasioned by work done during his absence. Figs. 4 and 5 show two workmen of the Manhattan Electrical Maintenance Company, of 298 West 137th Street, New York City, at work in an up-to-date apartment house. This company, under the management of Mr. George Brooke, has been one of the foremost in insisting that its men perform their work with the minimum of annoyance to the occupants of the buildings being wired.

Fig. 4 shows a wireman in the act of cutting an opening for an outlet box. In performing this piece of work the electrician marks upon the plaster the exact size of the hole which must be made to admit the box. With the aid of a chisel, brace and bit and a small saw the opening is neatly made. When the box has been inserted, the irregular edges are carefully replastered and covered by the switch plate, leaving a smooth clean surface. The workman seen in the hall is inserting a box into an opening which has already been prepared. The flooring in this instance has been removed at the side of the hall instead of in the center, as previously shown, for the reason that in this house tongue-and-groove flooring had been used. When flooring of this type is encountered it is generally found to be best to remove first the board which was the last to be put in place. In this way it is possible to remove a single board at a time without breaking the lap edges. The same method of getting the circuits beneath the second layer of the double floor was employed as in the former case.

Fig. 5 shows one method of drawing flexible steel conduit into a room which is to contain two outlets. The main outlet was to be placed in the position occupied by the former gas fixture. However, since the wall at the right of the picture was of solid brick construction on which the plaster had been placed without an intervening layer of lath, it was deemed wiser to station the other outlet above the dressing table, in the place formerly occupied by the bracket which previously had furnished the illumination for that table.

Two holes small enough to be covered by the canopy of the fixture were cut in the ceiling. An additional opening was made in the floor above at the vertex of a right angle formed at the intersection of two straight lines drawn from the outlets shown in the illustration. With a man at each opening the steel conduit was finshed from the side outlet to the center and connection to the main circuit was made at the opening on the floor above. This illustrates very well how a room with two outlets can be wired by cutting only a very few openings.

It is the policy of the contractor under whose supervision this work was done to complete the installation upon each floor in turn as far as possible before beginning the next. Only two electricians and one helper are assigned to each job, as this is thought to be the largest force that can work

FIG. 5—DRAWING IN FLEXIBLE STEEL CONDUIT FOR TWO OUTLETS

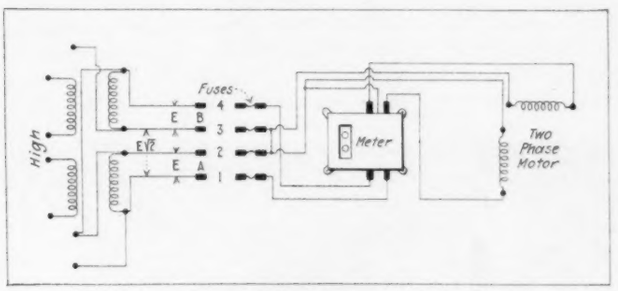
economically without disturbing the household while the wiring is being done.

It would seem that this is indeed the proper solution of the wiring problem, for the incidents cited by the contractor and his men show that the antagonistic housewife who at first refuses to let a "crew of dirty workmen" enter her home is soon an admiring advocate of the dirtless electric wireman.

Transposed Motor Circuits

By E. W. COPELAND

A contractor sent a small two-phase motor to the shop for repairs. The windings and bearings were carefully examined and apparently nothing was wrong, so the machine was reassembled and connected to a two-phase circuit. The motor was able to start and operate perfectly even under 50 per cent overload and it was returned to the owner marked "O.K." The next day it was reported that the motor still made considerable noise when in operation and became hot even when running light. An examination



WIRING DIAGRAM

of the motor under operating conditions showed the connections to be as indicated in the accompanying diagram. Testing above the fuses showed the potential to be 220 volts between 1 and 2, 220 volts between 2 and 3, 220 volts between 3 and 4, 312 volts between 1 and 3, zero between 2 and 4 and 220 between 1 and 4. Fuse 2 was burned out. With these connections it can be seen that 312 volts was impressed across the coils of one phase of the motor.

The connection between 2 and 3 was then severed and the blown fuse replaced, after which no trouble was experienced. Upon examining the connections at the transformer pole it was found that originally four feed wires had supplied energy to the various motors, but later when an elevator was installed in one of the buildings four heavy feed wires were run from the transformers and connected at another pole as shown in the sketch. Other motors of the plant were not affected as none of the other service switches were connected together at 2 and 3.

This case of trouble serves very well to illustrate the fact that in bringing wires into a building care should be exercised to insure that they do not become accidentally transposed. Unfortunately the ordinary wireman does not always carry a voltmeter with his kit of tools, but depends largely upon the relative position of the wires for determining the neutral wires of the circuit.

Recent Telephone Patents

ANTISEPTIC DEVICE

Mr. I. P. Mills, of San Francisco, Cal., is the patentee of an antiseptic device for transmitters which consists of an annular box of metal with ribs for clamping to a transmitter mouthpiece. The metal wall does not extend within the perforation of the box. The box contains a thick fibrous washer which is soaked with antiseptic solution. The perforations in the box and washer are in line with the sound passage of the mouthpiece.

CIRCUIT ARRANGEMENT

Mr. J. C. R. Palmer, of Brooklyn, N. Y., has patented and assigned to the Western Electric Company an arrangement of circuits for a multi-station line. The receiver is normally bridged on the line. The transmitter and induction coil are detached during the listening condition. To transmit a key must be depressed which connects a coil into the receiver circuit and connects the transmitting circuit.

Letter to the Editor

White Screens Before Audiences

To the Editors of the Electrical World:

SIRS:—In a number of assembly rooms there are white walls back of the platform used for showing lantern slides when occasion demands. Moreover, in a number of concert halls use is made of a sound shell over the platform, this shell being frequently painted a very light color. In many cases these white surfaces are highly illuminated even when they are not being used for lantern slides. Under some conditions such highly illuminated white surfaces in front of an audience may cause considerable eye discomfort. The amount of such discomfort will generally depend on the relative surface brightness of the screen or sound shell and of the surroundings of the screen or sound shell which are within the range of vision of the eyes looking toward the stage.

The cause of this kind of eye discomfort is not so much the intrinsic surface brightness of the screen or sound shell back of the stage as it is the contrast in surface brightness between such a screen or shell and the stage surroundings. The remedy is either to decrease the surface brightness of the screen or shell behind the platform or to increase the surface brightness of the surroundings. As surface brightness depends upon the amount of light falling on a surface less the amount of light absorbed by the surface in question, the surface brightness can be altered either by changing the amount of light directed toward the surface or by changing the color of the surface, or by both methods. Whether either one or both of these remedies should be used depends, of course, upon the circumstances of the case under consideration.

Chicago audiences have had two excellent opportunities to see the effects here spoken of. In the concert room known as Orchestra Hall the sound shell back of the stage was originally finished in a very light color. This sound shell is always highly illuminated during performances, and a very noticeable difference in the comfort of sitting through an evening in this hall depends on whether the general lighting of the hall is almost extinguished or whether there is enough general lighting to reduce the uncomfortable contrast between the light-colored sound shell and its surroundings.

Another example is the auditorium of the Western Society of Engineers in the Monadnock Block. This is illuminated by lamps placed above a skylight and equipped with reflectors so pointed that very little light shines in the eyes of those in the audience. Nevertheless, it was felt by many that something was wrong with the lighting of this room. It was at last concluded that the trouble came from the highly illuminated white wall back of the platform. The platform illumination was equipped with a trough reflector concealed back of a ceiling beam just in front of the platform. In order to give plenty of light on the speaker, enough lamps were provided in this trough to make the surface brightness of the white screen back of the platform very much higher than the surface brightness of the surroundings.

The directors finally authorized the purchase of a curtain which could be drawn across in front of the white screen when the screen was not in use for the stereopticon. The relief which the eye experiences when this curtain is pulled across in front of the white screen after the screen has been exposed for a time is very noticeable and is a matter of common comment. This curtain is of a medium tint, being neither very light nor very dark. Its sole purpose is to reduce the contrast in surface brightness between the screen in back of the platform and the surroundings. This it accomplishes very well and much to the comfort of Chicago engineering audiences.

Chicago, Ill. J. R. CRAVATH.

Field of the Operating Engineer

A Record of Practice, Experience, New Ideas and Interesting Problems—Notes on Practical Subjects—Questions and Answers

Effect of Flood at Bedford, Ind.

Among the many central stations which were entirely put out of commission by the floods which occurred late in March and early in April was that of the Southern Indiana Power Company of Bedford, Ind. The four photographs reproduced herewith, showing the machinery at the Williams plant, give a very vivid idea of the conditions during and after the flood. The water at its maximum stage was 6 ft. over the turbine-room floor and totally submerged all of the generating and remote-control switching equipment, comprising four 1000-kw, 2300-volt waterwheel-driven units, two 750-kw and one 2500-kw steam-turbine-driven unit and their control apparatus.

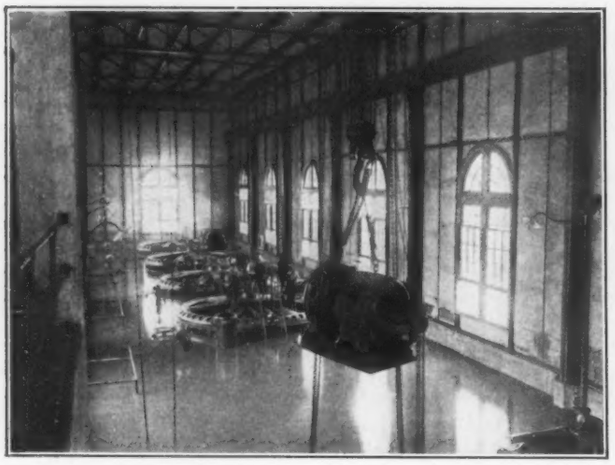


FIG. 1—WATERWHEEL UNITS PARTLY SUBMERGED

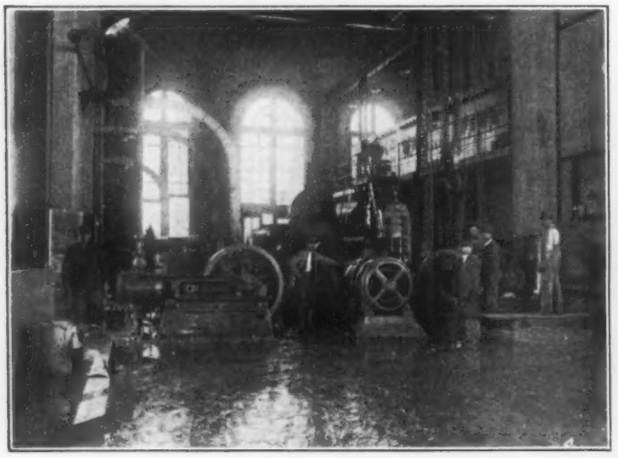


FIG. 2—CONDITION IN STEAM END AFTER WATER RECEDED

The generators were dried out by short-circuiting their terminals and circulating sufficient current through their windings to keep them at a temperature just below the softening point of the insulation. An oven built in the powerhouse yard while the flood was at its height was used in drying out the switching equipment and series and shunt instrument transformers. The oven was built with a brick floor upon which the switches and transformers were placed and under which a fire was kept burning. A circulation of air was secured through the apparatus being dried by means of a short wooden stack erected at one end of the oven.

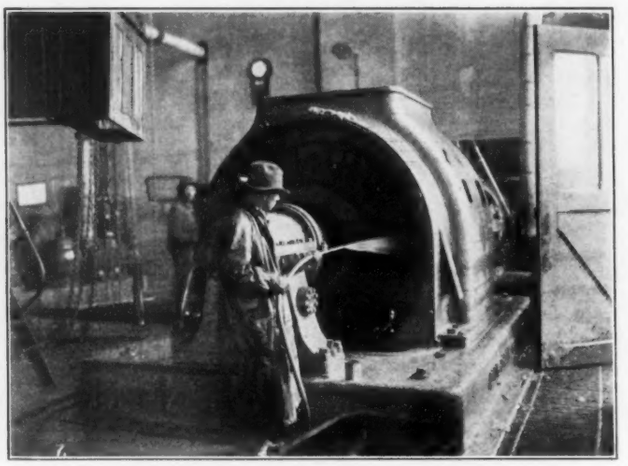


FIG. 3—WASHING MUD OUT OF TURBO-GENERATOR

Seven days of drying sufficed to raise the insulation resistance of the generators to 12 megohms, at which time the service was resumed and full load carried on the station apparatus. Some of the smaller apparatus such as motor-generator sets were lifted by the crane and propped up clear of the water as soon as it became evident that the flood would reach the station floor. Fig. 2 shows the mud left on the floor after the water had receded, and Fig. 3 shows the means employed to wash out the deposits left in the windings of the turbo-generator.

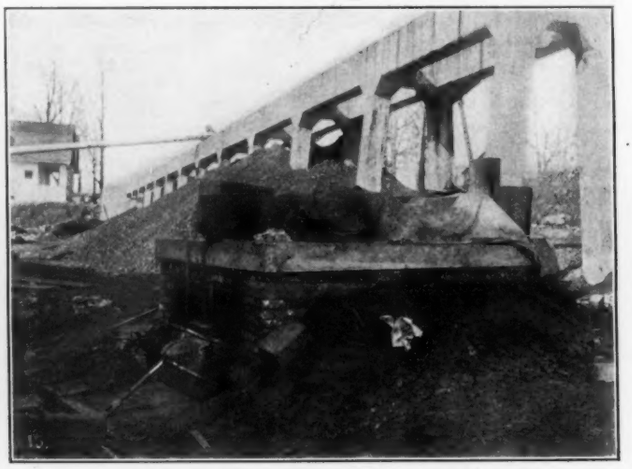


FIG. 4—OVEN USED IN DRYING SWITCHING APPARATUS

The problem solved by this company is typical of the problems that confronted central stations all through the flooded district.

Advisability of Keeping Operating Records

An item often lost sight of in turbine-driven stations where the temperature of the circulating water used in surface condensers is very low for several months in the year is the temperature of the condensate as compared with the temperature which it should have with the vacuum carried.

To cite a concrete illustration of this point, it was found by making a test in a certain plant that the temperature of the condensate leaving the turbine condenser was only 37 deg. Fahr. with a circulating-water inlet temperature of 34 deg. Fahr. and a vacuum of 28.52 in. referred to a 30-in. barometer. The temperature should have been about 81 deg. Fahr., and with condenser equipment of the latest type this could be raised to about 88 deg. Fahr., making a difference of about 51 thermal units per pound Fahr. for every pound of condensate returned to the hot-well. Reduced to dollars and cents, this loss represents a 6 per cent return on an investment of $47,000 based on a 4000-kw unit running twenty hours per day, with coal costing $2.50 per ton. Had the temperature of the circulating water been regularly taken at the inlet and outlet and the temperature of the condensate been recorded this condition of affairs would have been detected and remedied before such an unsatisfactory stage was reached.

Lessons from Line Troubles

The story of industrial accidents often serves to suggest profitable means of safeguarding future work, and the lessons of individual casualties often suggest lines of operation, construction or design which are improvements over former practice. In the following paragraphs are given the essential particulars of a number of accidents more or less closely related to the use of electrical apparatus with suggestions as to preventive measures.

In one instance a telephone lineman was killed by coming in contact with the high-voltage line of a large central station. The lineman was at work upon a cable box on a pole which carried four cross-arms, the highest being occupied by fire-alarm wires, the second and third by telephone wires, and the fourth, which was 4.5 ft. below the third, by two high-tension and two dead wires of the central-station company. The cover of the cable box, when raised, came in contact with the high-potential wire at a point where the insulation was worn off, and it appeared that this condition led to the fatality, the evidence indicating that in raising the cover the hand of the lineman came against the wire. The use of a cable box installed in such a way that its cover could have been freely opened and closed would probably have obviated the accident and would have been a simple preventive measure along the lines of safer service.

In another instance a lineman of a telephone company employed as a "trouble shooter" was injured in testing two telephone wires on a pole, these having been run across the street above the local central-station feeders. Originally the two circuits were separated by about 8 in., but the telephone wires sagged and during windy weather came into frequent swinging contact with the lighting feeders, the insulation on which had become old and chafed. Prior to the accident the occasional occurrence of a momentary arc at the point of contact had been observed by the line crew of the lighting company, but repairs had been neglected on the ground that the responsibility was the telephone company's affair, since it was the later occupant of the street. The case was carried to the courts, where both companies were held responsible, the need of better maintenance emphasized and the practice of separating such circuits by at least 18 in. advocated. The cost of the damages was probably 200 times the expense of safeguarding the crossing in the initial installation.

In still another case failure on the part of a large electric-service company to use a sufficiently strong type of construction at an angular section of a 20,000-volt, three-phase transmission line resulted in a fatal accident to a team owner who was driving on the highway. One of the wires fell into the roadway at the point where the direction of the line changed, and the cost of this accident in money alone was $20,000. It might have been prevented by proper mechanical construction or by closer attention to maintenance. The top wire of the circuit was carried on insulators attached by pins to a short cross-arm bolted to the pole in each case about 8 in. below the top. After the accident the cross-arm was found lying in the road with a broken pin and insulator. The cross-arm had been seen to be decidedly out of alignment prior to the accident and it appeared that the line department had failed to make repairs at this point after its attention had been called to the defect.

Reconstruction of a Storage-Battery Plant

After a number of years' service the storage-battery plant of the United Railways Company, St. Louis, was recently overhauled and partly reconstructed, due consideration being given to weaknesses in construction of the old battery. There were originally two batteries, each having a discharge rating of 2500 amp for one hour, and by means of series boosters it was possible to obtain a combined discharge of 5000 amp for one hour. The tanks were made

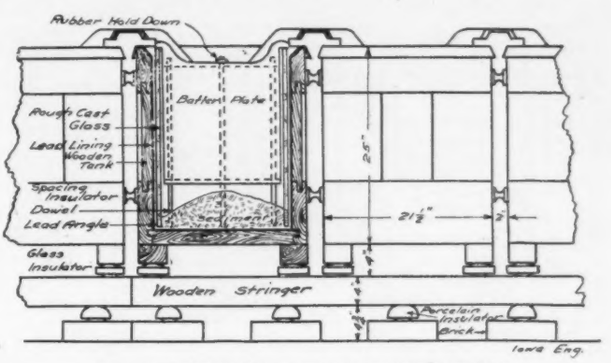


FIG. 1—ORIGINAL BATTERY CONSTRUCTION

of yellow-pine wood, which was found best adapted for the purpose.

The method of support and insulation is very clearly shown in Fig. 1. It will be noted that the porcelain insulators were spaced with no particular regard to the width of the cells, and thus it occasionally occurred that a row of these insulators came directly under the space between cells. Acid which collected on the edge of the overlapping lead lining dripped upon them and destroyed their insulating properties. The tanks were lined with lead of 1/16-in. thickness and all seams were burned together. Each tank contained seventy-seven plates, the positive being of the Manchester type. The electrolyte was dilute sulphuric acid of 1.210 specific gravity. Between each two cells was a heavy lead channel busbar, onto which were burned all the negative plates in one cell and all the positive plates in the next.

After six and one-half years of operation the plates were nearly worn out and the batteries very inefficient. The wooden tanks were badly decayed by the acid, as were also the wooden stringers under the cells, and the batteries were badly grounded. Five or six cells needed attention all the time. On this account a complete reconstruction was decided upon, and this was done by the railway company's own staff.

Fig. 2 shows the improved construction of cells. Each cell is an independent unit. Wooden blocks resting on bricks

form the support for the insulators. There are ten of these blocks and insulators under each tank. The space under the cells is clear so that a man can crawl under and replace any insulator or block. A new insulator was developed by the company. An annular space in the insulator contains oil, shown in black in the illustration. Any leakage would have to come down the center extension of the insulator, across the surface at the oil to ground. After two years' service the insulation is almost perfect. The new tanks without paneling have proved much stronger and do not require so many spacing insulators. The paneling of the old-type tanks was so constructed as to form a lodging place for acid drips, and the consequence was decay in the crevices.

The old tanks were removed to an upper floor, the lead lining removed, and after the lining had been inspected inside and out and repairs made if needed, the lining was installed in the new tank. All the old linings with a few exceptions were used over again.

The lead linings where they extend over the edge of the tanks were cut to form drip points. The point on each end was in the center and on the sides there were four points which came between the insulator spacing of the tanks. This scheme keeps the insulators free of acid from dripping.

A new type of positive plate known as the Tudor type was used. The new positives are practically pure lead plates, grid and active material. The plates are about ⅜ in. thick. The surface is cut into horizontal rows of finely divided grooves. Between the ⅜-in.-wide horizontal

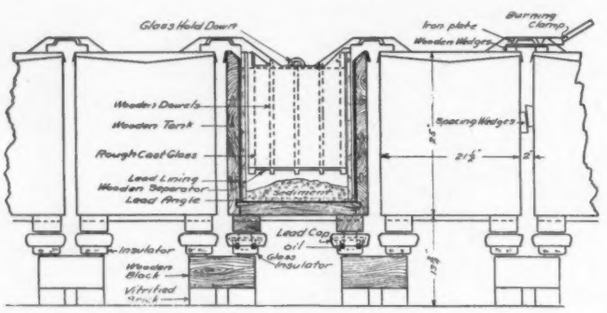


FIG. 2—TYPE OF CONSTRUCTION NOW USED

rows was left a web of the lead which was not cut. The active material was formed in the finely divided grooves. These plates were very easily buckled and required very rigid separation. The board separators were equipped with five dowels each. The outside dowels were 1 in. wide by ½ in. thick. The other three were ½ in. wide by ½ in. thick. These separators were suspended from the top of the plates by means of a rubber peg pushed through the top of the center dowel. The hold-downs are semicircular glass pieces about 8 in. long. Some of the old plates removed in the process of reconstruction did not have any of the active material remaining in them. Enough were found, however, to be sufficiently valuable to give a year's service in fifty cells.

DATA OBTAINED FROM WATTMETER TESTS (ONE WEEK'S AVERAGE)

	Before Rebuilding	After Rebuilding
Kw-hr. efficiency, per cent	32.1	43.8
Amp-hr. efficiency, per cent	45.3	51.3
Capacity discharge, amp-hr	960	2410

The negative plates are the plates from the original installation. They were found good for several years more of efficient service.

Some wattmeter tests made on one of the batteries before and after the reconstruction are recorded in the accompanying table. The weekly overcharge was distributed and charged to the amount of energy put into the battery, by adding one-sixth of the power required by the overcharge to the charge required by the battery, after a discharge, if a discharge occurred on six nights of a week following the overcharge.

COSTS OF ORIGINAL INSTALLATION AND RECONSTRUCTION

Two batteries installed complete with boosters, wiring switchboards and copper bars	$198,000.00
Cleaning out sediment, including pump, tanks, etc	2,223.13
Reconstruction 1910 and 1911	107,321.88
Board separators complete with dowels, each	0.15
Positive plates, each	4.00
Negative plates, each	3.65
Oil insulators, complete with alloy cap, each	0.40
Wooden tanks, railway company's manufacture, each	12.00
Lead linings, railway company's manufacture, each	15.00

In an article in a recent issue of the *Iowa Engineer* Mr. Charles A. Hobein describes the original installation of this storage-battery plant and the reconstruction work outlined in this article.

Vacuum-Heat Treatment for Drying Flood-Immersed Motors and Equipment

For drying out a large part of its shop electrical equipment, including motors, fans, fixtures, etc., which for seventy-two hours were immersed by the high waters of the recent Dayton flood and meanwhile covered with a thick deposit of mud, silt, etc., the engineers of the Platt Iron Works, of that city, improvised a successful vacuum-heat treatment with the aid of a condenser and air pump. Into a condenser drum 36 in. in diameter and 8 ft. long was piled the electrical equipment to be dried. Bolting up the head end of the drum, connection was then made with the suction line of an air pump, which reduced the air pressure to a "vacuum" of 14 in. to 16 in. of mercury column. The corresponding boiling point of water was thus depressed to 190 deg. Fahr., so that when steam was admitted to the coils the internal temperature could not rise above a value where the rubber insulation might be endangered. As fast as the various contents of the condenser drum were dried the head end-bolts were loosened and the dried apparatus replaced with more water-soaked equipment. Altogether in this way three carloads of motors, fans, sockets, fixtures, etc., were restored to usable condition without endangering the insulating material they contained—an achievement which, in view of the difficulties surmounted, is well worthy of record.

Power-Factor Correction

There is at present in our plant a 200-kw alternator which is carrying an induction motor load of 67 kw at about 33 per cent power-factor. If there is placed upon the line a 30-kw synchronous motor which is to be operated at no load, how much can the power-factor of the load be improved? I. F. R.

If the motor were placed upon the line and the excitation adjusted so that the motor would be taking full load wattless current, the power-factor would be changed in the following manner: With a power-factor of 33 per cent the wattless factor is 94 per cent, which with a total load of 200 kva means 188 wattless kva. When reduced by 30 kva to 158 kva, the wattless factor would be about 79 per cent and the corresponding power-factor about 61 per cent. These values are only approximate, no account being taken of the constant losses and the slight reduction in the kva on the system by reason of the reduced wattless volt-amperes.

Digest of Current Electrical Literature

Abstracts of Important Original Articles Appearing in the Periodical Electrical Press of the World

Generators, Motors and Transformers

Armature Windings in Air-Gap.—F. NIETHAMMER.—In calculating the magnetic circuit of machines the exact determination of the armature windings for the air-gap is often most important. There is a difficulty in this in so far as the effective air-gap length and the effective air-gap section do not agree with the real values on account of the presence of slots and the straying of the lines of flux. To determine the armature windings two methods are possible; either the real air-gap is used and the air-gap section is corrected or the real air-gap section is used and the air-gap length is corrected. Both methods are employed by the author in the discussion and calculation of various special problems.—*Elek. und Masch.* (Vienna), May 4, 1913.

Commutation.—G. W. WORRELL.—An article on the magnetic conditions prevailing in the commutation zone. The author shows that Binder's theory agrees with his own views.—*Elek. und Masch.* (Vienna), April 27, 1913.

Lamps and Lighting

Tungsten Daylight Lamp.—The spectral composition of the light of incandescent lamps differs considerably from that of daylight. Fig. 1 shows the difference. The abscissas

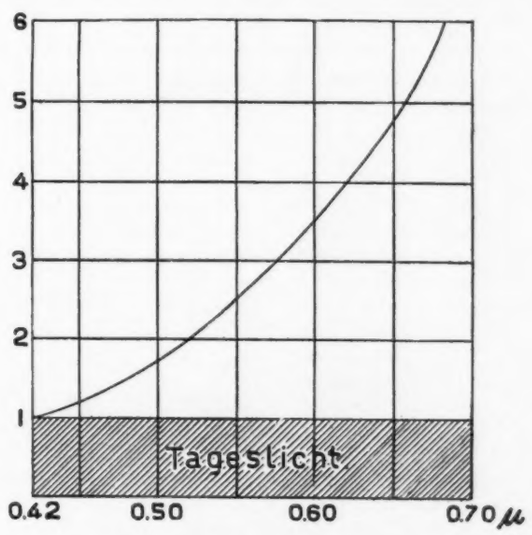


FIG. 1—CURVE SHOWING DIFFERENCE BETWEEN DAYLIGHT AND LIGHT FROM INCANDESCENT LAMPS

represent wave-lengths and the ordinates of the curve give the ratio of the intensities of the tungsten lamp and of daylight for the different wave-lengths, if the intensity of daylight and of the tungsten lamp is assumed to be the same at the wave length of 0.42 μ in the blue-violet portion of the spectral. If tungsten lamps are to give a light equal to daylight, part of the light of the other wave-lengths must be absorbed by special absorbing mediums, but the efficiency of the lamps is thereby greatly reduced so that the tungsten lamp producing exact daylight consumes not less than 4 watts per candle. That this is not worse is due to the fact that the rays which must be absorbed to the largest degree —the red ones—have a comparatively very small effect on the human eye. On account of the sensibility of the human eye with respect to different wave-lengths a German company has developed a lamp in which the absorption is restricted to wave-lengths between 0.48 μ and 0.62 μ. The rays of wave-lengths between 0.48 μ and above 0.62 μ are not changed at all. While this does not give a light exactly equivalent to daylight, it is for practical purposes sufficiently so, and there is not a great loss of energy. The Verico lamp of the Siemens & Halske Company is built for 100 watts and voltages of 100 to 130 and 200 to 250. The candle-power is from 70 to 75, so that the specific consumption is about 1.4 watt per candle. Globes of 120 mm are used for these lamps. The life is the same as that of the tungsten lamp and the color of the light does not change during life. The lamp is intended especially for silk, color, paper factories, etc., where it is important to distinguish colors as in ordinary daylight.—*Zeit. f. Beleucht.*, April 30, 1913.

Drawn-Tungsten Wire.—A note on a recent British patent (No. 9981, 1912) of C. H. Fischer. Pure anhydrous tungstic acid is reduced by a hot current of hydrogen in the presence of a volatile drying agent, for example, phosphorous pentoxide. The crystals of tungsten which are formed are separated out, cooled, pressed into flakes and then agglomerated, by pressing and simultaneously heating, into rods, which are then rolled in a machine which applies pressure at more than two points.—London *Elec. Eng'ing*, May 8, 1913.

Relative Visibility of the Different Colors of the Spectrum.—R. A. HOUSTOUN.—An account of an investigation carried out by a student society of Glasgow University. Light in the middle of the spectrum is much brighter than light at the ends for the same intensity of radiation in ergs per second per square centimeter. The brightness of any part of the spectrum in candles per square centimeter may be defined as the visibility of that part. To determine the relative visibility of the different parts of the spectrum we must determine the luminosity curve of the spectrum and the distribution of energy throughout it. The results of the tests are given in form of diagrams.—*Philos. Magazine*, May, 1913.

Generation, Transmission and Distribution

Electrically Driven Rolling Mill.—A. LAMBERTON.—An abstract of a paper read before the (British) Iron and Steel Institution on a new form of electrically driven two-high continuous-running reversing mill. The basic idea of the new system is that if in a mill with two rolls arrangements can be made to make the bottom roll the top roll, and vice versa, then at each reversal of the position of these rolls there will be a pass in the opposite direction. If, then, a pair of rolls be mounted in circular gables, which are free to rotate in fixed frames or housings, this will afford a continuous-running two-high mill, which gives reversals at each pass on the gables being rotated through an angle of 180 deg.—half a revolution.—London *Electrician*, May 9, 1913.

Electric Winding in Mines.—L. B. WOODWORTH.—A paper read before the South African Institute of Electrical Engineers on details of using the three-phase system in electrical winding installations in mines, with reference to troubles experienced in practice and methods of avoiding them and with a description of the different controllers in

use. Efficiency is not everything to be desired. Slightly lower efficiency combined with good running qualities, ease of repair and reliability are to be desired rather than higher efficiency, increased cost and difficulties of repair and the constant dread of the rotor and stator laminations touching. —*Transactions South African Inst. Elec. Eng.*, February, 1913.

Surface Combustion.—C. D. McCourt.—An illustrated article on the "Bonecourt" process of surface combustion, which consists essentially in passing a mixture of gas and air in the proportions for complete combustion through or over porous bodies. As soon as a certain temperature is reached the combustion proceeds on the porous surfaces, and radiant heat is the result as distinct from flame. The theory underlying this process is explained, and some details are given of the results obtained in practice.—London *Electrician*, May 2 and 9, 1913.

Traction

Mountain Railroad Locomotive.—A profusely illustrated detailed description of the 800-hp single-phase locomotives of the Mittenwald mountain railroad. The motor is directly connected to the axle without gearing. There is no artificial cooling. The emf on the trolley wire is 15,000 volts (frequency 15 cycles per second). The voltage is reduced to 300 at the motor, which is a compensated repulsion machine.—*Elek. und Masch.* (Vienna), May 4, 1913.

Storage-Battery Cars.—H. Beckman.—The conclusion of his paper read before the Electrical Society of Vienna on modern storage-battery cars and motor trucks.—*Elek. und Masch.* (Vienna), April 27, 1913.

Industrial Locomotives.—F. Riep.—The conclusion of his illustrated article on the principles of design of electric locomotives supplied with energy from a trolley wire, for mines and other industrial purposes.—*Elek. Zeit.*, May 1, 1913.

Installations, Systems and Appliances

One Three-Phase Versus Three Single-Phase Transformers.—William Nesbit.—An article illustrated by diagrams discussing the relative advantages and disadvantages of three single-phase versus one three-phase transformer with respect to the disarrangement of service in case of breakdown, cost, efficiency, floor space, weight, insulation failures, etc. The author concludes that there are so many minor advantages and disadvantages applying to each type of transformer that a concrete summary is difficult, but that for feeding energy to motors, rotary converters and motor-generator sets three-phase transformers will in the near future be very generally employed. In an editorial note on the same subject A. B. Bender points out that for general distribution work where the market is to be gradually developed the single-phase lighting load is usually developed first. In this case it is best to install first one single-phase transformer and to add a second and a third unit later.—*Elec. Journal*, May, 1913.

Safety of Electric Installations.—G. Dettmar.—The first part of an article giving data on electrical installations for lighting, power and traction in Germany, with special reference to the question of liability of causing fires, accidents to workmen, etc. A great many statistical data are given covering a long series of years. The article is to be continued.—*Elek. Zeit.*, May 8, 1913.

Electric Plant at Fusan, Korea.—J. Douglas Collier.—An illustrated article on the new electricity works at Fusan, Korea. The generators are gas-driven and the two main sets have a rating of 300 kw each at 3500 volts, three-phase, 50 cycles.—London *Elec. Review*, May 9, 1913.

Electric Restaurant.—An illustrated description of a new fashionable restaurant in Kensington, London, in which not only all the cooking operations but also bread-baking, ventilating, heating, refrigerating and time service are to be carried out electrically.—London *Electrician* and *Elec. Review*, May 9, 1913.

Electrophysics and Magnetism

Stability of Residual Magnetism.—N. H. Williams.—An account of an experimental investigation in which an oscillographic method was developed for plotting any kind of a magnetic cycle with an alternating current of 60 cycles provided eddy currents and end effects are negligible. The method is applicable when the flux variation is as small as 150 lines of induction, and it may be used for any cycle in which the flux variation is greater than that amount. It was shown that in a given specimen, for any value of residual magnetism, there is a definite elastic limit which is the maximum field that can be applied to the specimen without producing permanent demagnetization, and that if any field not exceeding the limiting field be applied and then removed, the specimen will return to its original condition. Within the elastic limit, magnetic stress and strain are approximately proportional; that is, the demagnetization is approximately proportional to the field intensity that produces it, provided the specimen returns to its original remanence when the field is reduced to zero. The hysteresis as indicated by the area of the curves is small and is approximately the same for soft iron and hard steel. The extreme points of the stable demagnetization and recovery curves lie inside the maximum hysteresis curve. The susceptibility to small demagnetizing fields increases slightly with decrease of residual magnetism, the maximum difference observed being about 8 per cent. The recovery from the effect of a demagnetizing field is greater for low value of residual induction. For hardened steel it was found to be 1960 lines of induction per square centimeter, or 24.5 per cent of the maximum residual induction. For drawn piano wire it was 1200 lines per square centimeter, or 8 per cent of the maximum remanence, and for soft iron it was 600 lines per square centimeter, or 6 per cent of the maximum remanence. These numbers represent the elastic limits for low values of residual magnetism. There is shown to be a well-defined upper limit beyond which the residual magnetism of an open magnetic circuit of steel cannot be made to pass. For hard steel the elastic limit is approximately proportional to the difference between the residual magnetism and the maximum magnetism.—*Phys. Review*, May, 1913.

The Hall Effect.—Alpheus W. Smith.—An account of an investigation the chief results of which are as follows: An increase of temperature causes changes in the Hall effect and in the Nernst effect in monel and nichrome which are very similar to the changes produced in nickel, iron and cobalt under corresponding conditions. The Nernst effect and the Hall effect in monel and in nichrome depend on the temperature in essentially the same way. The addition of small quantities of silicon to iron causes a large increase in the Hall effect and a decrease in its temperature coefficient. Under similar conditions there is at first a decrease in the Nernst effect, then a reversal of its direction and an increase to a larger value in the opposite direction. Associated with this reversal of the Nernst effect is the reversal of the thermo-electromotive force against copper. In a transverse magnetic field the resistance of monel and nichrome behaves like the resistance of nickel except that the changes under corresponding conditions are less than in nickel. The influence of tension on the longitudinal change of resistance in a magnetic field in monel and in nickel is the same except for magnitude. Large quantities of occluded hydrogen do not change the Hall effect in palladium. In the neighborhood of 275 deg. C. there is a molecular transformation in tellurium. The Hall effect after this transformation is about double its value before the transformation. The Hall effect has been determined in iron pyrites and galena. In these crystals the Hall electromotive force is proportional to the magnetic field.—*Phys. Review*, May, 1913.

Absorption of Electric Waves by Air and Steam.—J. E. Ives.—An account of an experimental investigation the

results of which show that for electric waves about 10 cm long passing through air at pressures ranging from 76 cm to 0.001 cm of mercury, and through water vapor at pressures ranging from 1.50 cm to 0.015 cm, the absorption of the energy of the waves by the air, if it exists, must be less than one-tenth of 1 per cent per centimeter. This was also found to be true when the air was ionized by radium chloride placed in open vessels within the tube. This would indicate that the ionization of the air by radium produces, if any, only a very small effect upon its absorbing power for electric waves about 10 cm long.—*Philos. Mag.*, May, 1913.

Radio-Activity.—A paper by A. Flek on the existence of uranium Y reaches the conclusion that all attempts to confirm the existence of the substance called uranium Y were unsuccessful. A paper by J. A. Cranston discusses the growth of radiothorium from mesothorium 2. A paper by E. Rutherford and H. Richardson deals with the analysis of the gamma rays from radium B and radium C. A paper by A. van den Broek discusses the quantitative relation between the range of the alpha particles and the number of charges emitted during disintegration.—*Philos. Mag.*, May, 1913.

Discharge of Electricity from Incandescent Bodies in a Vacuum.—G. OWEN AND R. HALSALL.—An account of an investigation in which the nature of the carriers, in a vacuum, of the negative thermionic currents from palladium, pure and commercial platinum and iridium was studied. The carriers consist almost entirely of free electrons. If any of the discharge is carried by heavy ions, then the proportion of heavy ions to electrons is, for all temperatures, certainly less than one part in two thousand and probably less than one part in ten thousand.—*Philos. Mag.*, May, 1913.

Egg-White.—E. F. NORTHRUP.—An illustrated note describing some experiments on the electrical properties of egg-white.—*Journal Franklin Institute*, April, 1913.

Units, Measurements, and Instruments

Measuring the Degree of Irregularity in the Speed of a Motor During One Revolution.—H. ARMAGNAT.—At the recent instrument exhibition of the French Physical Society in Paris there was shown a modification of the apparatus of Boucherot for measuring the degree of irregularity of speed of a motor during one revolution, which was described and illustrated in the *Digest* Feb. 22, 1913, page 419. Instead of the instrument shown in Fig. 4 at that place the instrument shown in Fig. 2 is now used. It is a small galvanometer with movable coil *C* mounted on pivots and provided with a mirror. The directive force is produced by two springs *RR* which act on the end of the

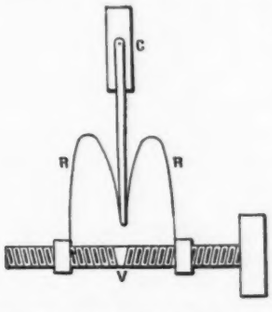


FIG. 2—INSTRUMENT FOR MEASURING SPEED VARIATION

needle. The tension of the springs is adjustable by means of the screw *V*, which permits one to change the distance between two nuts. The sensitiveness of the modified apparatus is such that at a distance of 1 m the amplitude of the oscillations of the movable spot covers the whole scale with 25,000 ohms in the circuit. When resonance has once been established the tension of the springs is slightly changed in order to produce surging and the amplitude of the oscillations is varied by changing the resistance in the circuit which can be brought down to about 2500 ohms. The whole measurement depends on the ratio of the resistance. The apparatus is adjusted for the mean frequency and permits variations of 10 per cent from its frequency. M. Blondel has found another solution of the same problem. A generator giving an emf strictly proportional to the speed is attached to the motor under test and the generated current is supplied to a resonance galvanometer. It is sufficient to decompose the current by resonance in order to know the frequency of the amplitude of the irregularities. For this purpose use should not be made of a commutator generator, which would introduce into the emf all kinds of harmonics. Blondel uses a uni-polar generator, the armature of which is a copper cup revolving in a cylindrical air-gap. Stationary brushes collect the current. The emf is about 0.01 volt for 100 r.p.m.—*La Revue Elec.*, May 2, 1913.

Reductor for Ballistic Measurements.—H. ARMAGNAT.—An illustrated description of the Mamlok "reductor" shown at the recent instrument exhibition of the French Physical

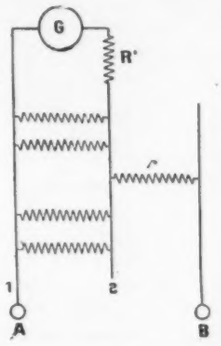


FIG. 3—RESISTORS IN PARALLEL

Society in Paris. In ballistic measurements it is often necessary to vary the sensibility of the galvanometer in a certain proportion. It is necessary, first, that the galvanometer be always closed through the same resistance, and second that the product of the multiplying coefficient of the shunt and of the resistance of the induced circuit shall vary in a certain proportion. In the "Mamlok" reductor the shunt consists of a number of resistors in parallel (Fig. 3), one of these resistors being withdrawn from the parallel

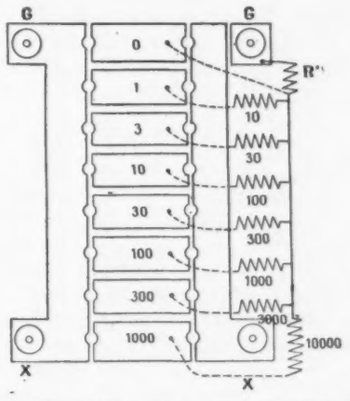


FIG. 4—RESISTANCE BOX GIVING DESIRED RATIOS

connection and connected in series with the induced coil in the case of ballistic measurements, or in parallel with the circuit through which the current to be measured passes. If *R* is the resistance between the points *A* and *B*, *m* the multiplying coefficient of the shunt and *i* the current in the galvanometer, and if the terminals *A* and *B* are connected to a resistor of small resistance, with a potential difference

U between the ends of the resistor, then $U = Rmi$. Likewise if A and B are connected to a resistor of small resistance which is subjected to a flux variation $d\Phi$ a quantity of electricity g will pass through the galvanometer so that $d\Phi = Rmg$. It can be easily shown, however, that Rm is proportional to r (the resistor in the right-hand branch of the diagram). The shunt is, therefore, made up of resistors having the desired ratios of resistance in the form of a resistance box, as shown in Fig. 4. The coil is connected to the terminals XX and the galvanometer to GG. One single plug is inserted at the right, all other plugs at the left. The multiplying factor is then indicated by the number printed on the single plug at the right. An additional resistor R' is used to regulate the damping of the galvanometer.—*La Revue Elec.*, May 2, 1913.

Electrostatic Instruments.—C. C. Paterson, E. H. Rayner and A. Kinnes.—A paper in abstract presented before the (British) Institution of Electrical Engineers in which the authors describe the electrostatic instruments now used at the National Physical Laboratory for the measurement of alternating currents, pressure and power. Some applications of the instruments are also given. In addition to the electrostatic wattmeter, the quadrant voltmeter and the Campbell method of measuring large alternating currents are described.—London *Electrician*, May 2, 1913.

Thermopiles.—W. W. Coblentz.—A note on the construction of thermopiles for monochromatic illuminators. The author describes some tests on the relative sensitivity of bismuth-iron and bismuth-silver thermopiles.—*Journal Franklin Institute*, May, 1913.

High-Pressure Tests.—An account of a general discussion before the South African Institute of Electrical Engineers on the value of high-pressure tests on windings, etc., of electrical machinery. What should be the values of the pressures used and for what periods should they be applied?—*Transactions South African Inst. Elec. Eng.*, February, 1913.

Telegraphy, Telephony and Signals

Receiving Two Messages by One Antenna.—H. Thurm.—For the reception of two wireless telegrams heretofore two separate antennas were necessary, each of which was connected with a receiver. The Telefunken company has devised a method in which one antenna is sufficient with two receivers for receiving two wireless telegrams at the same time. The antenna is switched alternately from one receiver to the other at such rapid intervals that even within the period of a point in the Morse alphabet either receiver is connected several times to the antenna. The arrangement permits an independent working of the two receivers; the switching arrangement is described and illustrated.—*Elek. Zeit.*, May 8, 1913.

Miscellaneous

Consulting Engineers in Germany.—An editorial note stating that "the position of consulting engineers in Germany cannot be a very happy one, if credence is to be attached to a statement made in the Prussian Diet in the course of the proceedings on April 19 in connection with the second reading of a government bill to authorize the conversion to electric traction of the Berlin City and Circle Railways. As is known, the bill had previously occupied the attention of a commission, whose proceedings were private, although an official report in a brief form was issued at the termination of each day's sitting, summarizing the general course of the deliberations. The commission heard and called for expert evidence on the proposals for electrification of the railways in question, but the names of the witnesses have not been disclosed. The reason, according to the statements made in the Prussian Diet by Herr von Pappenheim, is quite simple, although showing a surprising state of affairs. When the experts were examined by the commission, and were asked to intimate their opinions, they almost invariably expressed the wish that the attitude they assumed should not be allowed to be made public, and that their names should also be withheld, as they feared that they would have to suffer injury in the further progress of their science and profession from those at the back of the government scheme. Commenting on this statement, a Berlin newspaper remarks that affairs in the electrical industry are such that experts outside of the large undertakings apprehend personal disadvantages if they express opinions which differ from the business interests of these undertakings."—London *Elec. Review*, May 9, 1913.

Education of Engineers.—Norman Harrison.—A paper read before the South African Institute of Electrical Engineers on the education and training of engineers. The author discusses successively the following questions: What is required of an engineer? What has been done in the past to provide engineers? What is being done at the present time? He finally gives an outline of a proposed action to be taken in the future. He emphasizes that "it is useless for a single individual to move in a question of this kind, because no matter how carefully he may approach the subject, there is bound to be a tendency to bias the directive effort in the direction of a particular line of business. If, however, the electrical, mechanical and civil engineering societies took up the case jointly, this bias would be eliminated, and it would be easy to arrive at a course of study which would be suitable as a groundwork for all branches of engineering work."—*Transactions South African Inst. Elec. Eng.*, January, 1913.

Slaby.—A biographical sketch by Reithoffer of the work of the late A. Slaby.—*Elek. und Masch.* (Vienna), April 27, 1913.

Book Review

The Design of Alternating-Current Machinery. By James R. Barr and R. D. Archibald. New York: The Macmillan Company. Cloth; 496 pages, 340 illus., 17 working drawings. Price, $3.75.

Mr. Archibald says in the preface that "This book was written by the late Mr. James R. Barr and was intended to be a companion volume to his book on 'Direct-Current Electrical Engineering.'" Mr. Archibald, who is the head of the electrical engineering department at Dundee Technical College, undertook the revision and the editing of Mr. Barr's manuscripts. The work treats of the theory and design of alternating-current transformers, generators and rotary converters and, as stated in the preface, it is patterned somewhat along the lines pursued by Arnold and La Cour in their theoretical treatise. The book before us deals with the theory of wave form, of insulation and insulating materials, of the fundamental principles of transformers and of the design of transformers. Then follow the chapters on alternators, their theory and design, and methods of testing. The theory of parallel operation is then discussed and the periodic time of free oscillations is given. In connection with this theory the author gives the determination of the proper inertia of the flywheels and the now generally adopted theory that this inertia should be such that the free or natural period of oscillation will not coincide with forced impulses received from the prime mover. Examples of the design of alternating-current generators and turbo-generators are then introduced, with very excellent plates illustrating examples of English practice. The concluding chapter deals with rotary converters, their theory and design, and good plates illustrative of their design are found embodied in the book. The great care and thought bestowed by the authors upon this work, and the accuracy of the treatment, make it a most useful book for the student of electrical engineering.

New Apparatus and Appliances

An Illustrated Descriptive Record of Recently Developed Manufactured Products of Interest to Electrical Readers

Pressed-Steel Cable Supports

The design of the guy clamp illustrated herewith is based upon the principle of introducing a slight bend in the cable, enabling it to exert a greater holding power than could be established by means of the friction grip alone. The clamp proper is made from pressed steel in one piece. In applying the clamp it is laid upon the two strands, each fitting into a recess provided on either side and the T-headed bolt turned into the position shown in the cut. The bolt head is then turned at right angles and is pulled down onto the cables by setting up the nut. This gives a slight bend to the cable, which affords a holding power said to be in excess of the strength of the rope.

This method of application avoids the necessity for removing the bolt when the clamp is applied and reduces materially the time and labor required for application. The design shown in this illustration is of the single-bolt type, intended for a pull of 1200 lb. and for 0.25 in. and 5/16-in. wire. The two-bolt unit for ⅜-in. and 7/16-in. strands is provided with a bridge in the center between the bolts to give a double bend to the strand. This gives it a holding strength which in a test has been found to be in excess of 15,000 lb.

A cable bracket, also made of pressed steel throughout, is composed of a slotted rack into which are inserted any desired number of bracket arms. The rack is made in the form of a channel-iron and is furnished with an offset end at the bottom, thus permitting a number of racks to

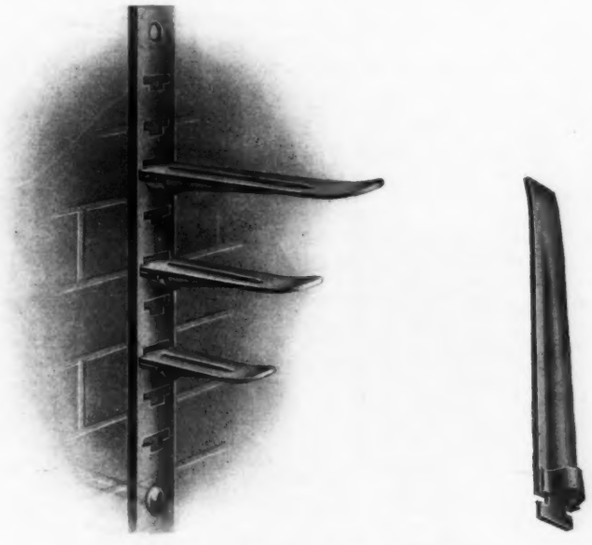


FIG. 1—CABLE BRACKET AND ARM

be placed one above the other to form a continuous piece. There are T-shaped slots in the rack at intervals of 1.5 in., which allows the bracket arm to be set at any desired elevation with a close degree of adjustment.

The bracket arm is made with a T-shaped head, the wings of which catch in the narrow part of the T-shaped slot in the rack when the arm is in place, and a groove is pressed into the arm to give it transverse strength as a beam in carrying its load. At the inner end of the arm is electrically welded a heel-piece of steel which rests against the face of the rack, serving to take the exhaust set up by the presence of a weight at the end of the arm. The arms are made in 10-in., 7-in. and 4-in.

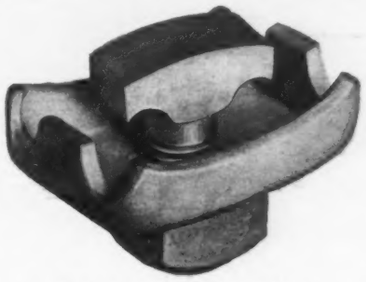


FIG. 2—GUY-WIRE CLAMP

lengths to suit different conditions and are wide enough to prevent any cold-flow of lead cable sheaths resting upon them. The bracket is strong enough to hold a 200-lb. weight on the end of the 10-in. arm.

These cable-line accessories are manufactured by the Barnes & Kobert Manufacturing Company, New Haven, Conn.

Electric Starter for Automobiles

The electric starter made by the Rushmore Dynamo Works, Plainfield, N. J., operates at 6 volts, which is the standard emf for automobile lighting. The motor is a series-wound machine geared directly to the flywheel. The pinion is keyed fast on the armature shaft and the entire armature moves endwise to engage and disengage the pinion. The shifting gears and ratchet drive are eliminated, and it has been found unnecessary to employ even a friction clutch to protect the motor against "back kicks" due to advanced spark. This is accomplished by making the motor powerful enough to turn the engine over in spite of a premature ignition.

The engaging and disengaging of the armature pinion with the flywheel gear is accomplished by displacing the armature endwise by means of a compression spring contained in the shaft, which is bored hollow to a depth of 10 in. for this purpose. The spring bears with a pressure of about 15 lb. against the hardened pin or plunger which runs against the end cap of the bearing, as shown in Fig. 2. In this position the pinion is out of mesh with the flywheel gear. When the switch is closed the field magnet poles attract the armature like the core of a solenoid into its working position with the pinion properly engaged. The armature then starts to turn.

The instant the engine picks up speed the motor is relieved of its load and the current drops. Thus the solenoid action ceases and the spring instantly pushes the armature into its idle or free running position where it spins idly until the operator releases the foot switch. Since the gears unmesh themselves the instant the engine starts the noise incident to gears overrunning a ratchet clutch at high speed is avoided.

To carry out the detail of the system the switch has two active contacts. The first contact partly short-circuits the armature so that it rotates only enough to allow the pinion to slip into mesh, while a resistance limits the current to that required to excite the field magnet. On the second contact the short-circuit is removed and the resistance cut out and the motor then exerts its full power to turn over the engine. In order that the switch movement shall not be too abrupt it is opposed by a stiff spring. On the release motion the switch arm jumps the armature short-circuiting contact.

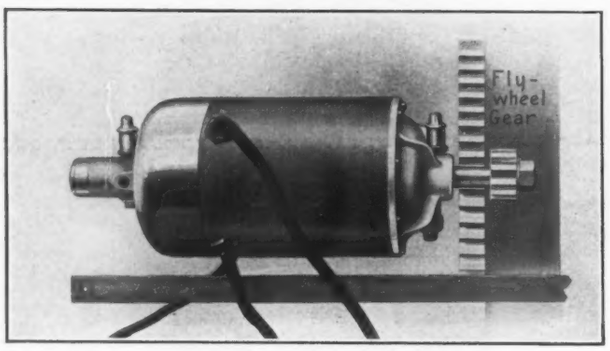


FIG. 1—ELECTRIC STARTER FOR AUTOMOBILES

The motor is of the ironclad type with four poles and four brushes. The commutator is long enough to provide for the endwise movement. Copper-gauze brushes of low electrical resistance are used. Sufficient oil reaches the commutator from the adjacent bearing to keep it lubricated. It is stated that the commutator, being sparkless and self-lubricated, requires no attention from the user. It is claimed that owing to certain electrical features of design and to the absence of intermediate gears the efficiency from battery to pinion is as high as 75 per cent. This permits the use of a moderate-size battery. The model B starter, 6 in. in diameter and weighing 47 lb. without the switch, will easily turn a 60-hp, six-cylinder engine at 80 r.p.m. while drawing 100 amp from the battery. With a smaller engine the speed may be from 100 to 150 r.p.m., thereby making it possible to start directly on the magneto.

Owing to the extreme flexibility of the series motor, a given winding and gear ratio will cover a very wide range of engine sizes. It is stated that the model B starter develops a torque of about 62 in.-lb. when running at 750 r.p.m., taking a current of 125 amp at 5.75 volts, at which output it shows an efficiency of approximately 73 per cent. At the instant of starting, the torque may be several times this value.

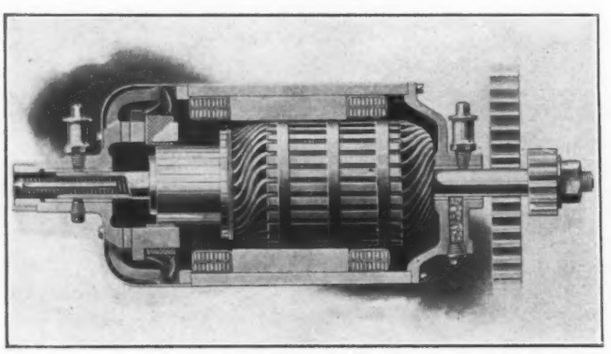


FIG. 2—SECTION OF ELECTRIC STARTER

It is stated that when taking a current of 300 amp with the battery at 5.5 volts the motor will exert a torque of 206 in.-lb. at 440 r.p.m., at which output it shows an efficiency of approximately 65 per cent.

Single-Phase Motor for Cylinder Printing Presses

The Kimble Electric Company, Chicago, has placed upon the market a single-phase motor for cylinder printing presses and similar machines, which is of the series-compensated type. It has the usual series characteristics, namely, high starting torque, sturdiness, simplicity and wide speed range. On account of the method of control the higher speeds of the range are not attended by a reduction of torque. The motor can exert a constant torque at any speed within its range. Its output in horse-power therefore increases with the speed, which is a feature not possessed by the direct-current motor or induction motor. These features make the motor an ideal form of drive for cylinder presses. The motors range in size from 1 hp to 5 hp.

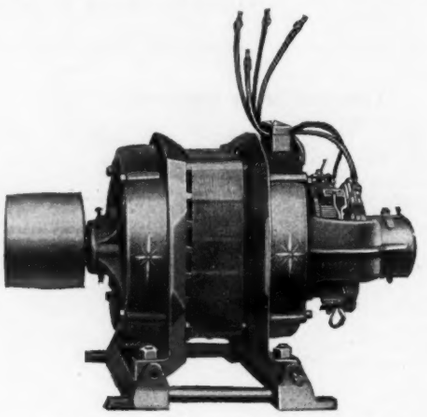


FIG. 1—SINGLE-PHASE MOTOR FOR PRINTING PRESS

The speed control is accomplished by varying the impressed voltage by means of an auto-transformer; no resistors are used. The use of the auto-transformer brings about a considerable reduction in the quantity of current required in starting and for all speeds except the maximum. The 60-cycle motor, it is said, will start against 100 per cent of full-load torque, with 60 per cent of full-load current and 29 per cent of full-load power from the line. This result is extremely good, as compared with a slip-ring polyphase motor or a direct-current motor, either of which would take about one and seven-tenths times the current and three and one-half times the power this motor takes to start the same load.

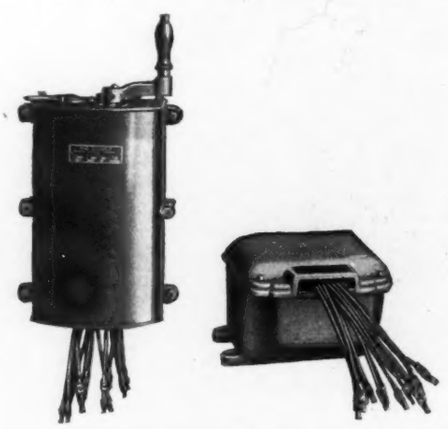


FIG. 2—STARTING DEVICE FOR MOTOR

The 60-cycle motor is able to start under three and two-fifths times the full-load torque, this feature enabling the motor to accelerate promptly.

As evidence of the sturdiness of the motor and controller it is said that the motor may be thrown repeatedly

from full speed in one direction to full speed in the opposite direction, without injury to any part of the apparatus. This result is partly due to the presence of some reactance in the motor circuits which prevents the passage of an excessive current through the windings, even though full-line voltage is applied with the armature stationary. Under such a condition only about three times full-load current would pass through the windings, and this would not endanger them unless continued for an appreciable time. The commutation is very good even on excessive overloads. This result is attributed to the large number of segments and the resulting small reactance voltage and to the grade of brush employed. No resistance leads are used, and hence repairs can be made outside of the factory by any competent workman. The temperature rise on continuous full load is 38 deg. C.

The controller provides for eighteen forward and eighteen reverse speeds. Each step of speed amounts to 3.5 per cent of the maximum speed. The speed control is flexible and is said to be capable of meeting the exacting requirements of color printing. On the controller are two handles, the main and the auxiliary, so interlocked that only one can be operated at a time. The auxiliary handle is removable, and its removal leaves the controller locked in the "off" position, thus making it impossible to start the press until the handle is returned. This arrangement safeguards both the press and the operator against accidents. Each notch of the auxiliary handle gives a speed change of 17.5 per cent of the maximum, and each notch of the main handle divides this large step into six smaller steps. Three such ranges are obtainable by shifting the position of the auxiliary handle, thus making a total of eighteen speeds. The reverse speeds are obtained by simply throwing the main handle in the opposite direction.

The controller is compact, being 17.25 in. high, 10.5 in. wide, and projecting 6.5 in. from its support. All hinges and contacts are replaceable without disturbing any connections.

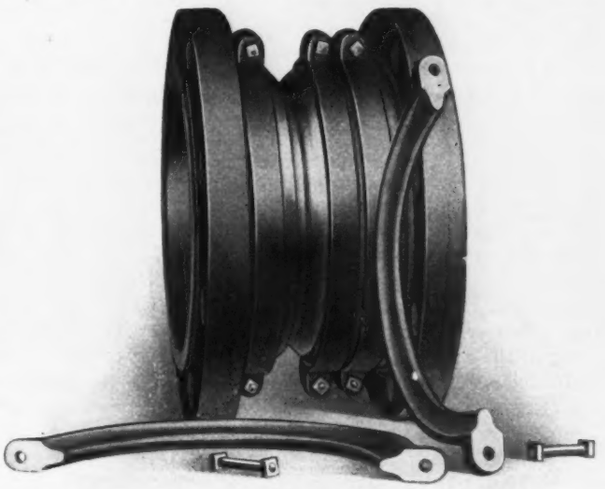
The efficiency of the motors at the rated speed is about the same as that of slip-ring induction motors of similar rating when the latter are operated without external rotor resistance. At lower speeds the single-phase motor has a better efficiency than the induction motor, and the difference is greater the greater the speed reduction. At three-quarters maximum speed the induction motor will consume about 27 per cent more power than the single-phase motor, and at half speed about 70 per cent more power. At 38 per cent of full speed the induction motor will consume twice as much power as the single-phase motor. This result is largely due to the avoidance of losses in the control of the single-phase motor.

Self-Equalizing Expansion Joint

The "Badger" self-equalizing expansion joint is a corrugated copper joint having external rings and is designed to take up changes in length of pipe lines conveying steam, water or air. The external rings on the corrugations distribute the strain and by thus bringing many corrugations into service no one of them is called upon to take more than its share of the strain. The rings force a part of the strain to the next corrugation and as each corrugation has only a slight movement the joint is said to last almost indefinitely.

The number of corrugations depends upon the pressure and upon the length of the joint. For high pressures and superheated steam the change in length is considerable and, therefore, more corrugations are used. For very low pressures, as in exhaust piping, two or three corrugations are sufficient for the slight alteration in length. There are even some cases where the expansion is small but vibration must be taken up, in which case the joint does not need any external rings. But in most cases external rings are used both to add strength and also to stiffen the exhaust pipe against collapse.

This joint, which is made by the E. B. Badger & Sons Company, 63-75 Pitts Street, Boston, is available in a complete line of sizes for all pressures and with flanges drilled to A. S. M. E. standards, for both high-pressure and extra-



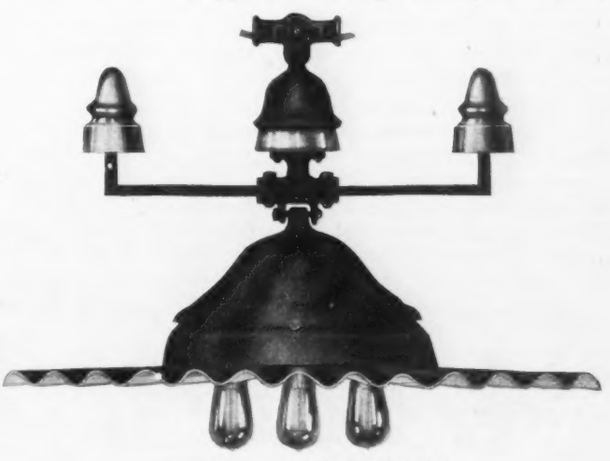
SELF-EQUALIZING EXPANSION JOINT

heavy pressure. These joints require no packing and take up no more room than a pipe fitting. For low-pressure work they have been made in sizes up to 6 ft. in diameter and are oval, rectangular, circular and in special forms.

Outdoor Tungsten Fixture

What is claimed to be the largest size fixture reflector made is employed on a new street fixture put on the market by the Line Material Company, of South Milwaukee, Wis. This radially fluted reflector is 26 in. in diameter, which is from 4 in. to 8 in. larger than the type usually employed for this purpose.

There are several types of this large fixture, for bracket



OUTDOOR TUNGSTEN FIXTURE

suspension, for pulley and rope suspension, for mast-arm suspension and for span suspension, the last one being shown in the illustration. This fixture swivels at two points, thereby insuring the proper hanging, but where a rigid fixture is desired it is only necessary to tighten the half-inch bolt above the reflector.

The lamps, sockets, reflector and channel arm are sup-

ported by a special high-voltage insulator, which protects the series cut-out sockets and other live parts from grounds or leakage of current. It is so designed that even if it should break the fixture will not drop to the ground. For the support of the live wires a steel channel arm is provided, which has the so-called "Hendee" insulator tips. These allow for contraction and expansion and for irregularities in the grooves of the insulators.

Aluminum for Electric Vehicles

Aluminum possesses a number of most desirable features as a material for automobile bodies. Its extreme lightness is combined with great strength, it will not warp, is unaffected by weather conditions, will never rust and permits the application of a non-cracking satin finish. It also possesses the quality of being easily malleable. For the purpose of shaping the plates special pressing machines and automatic hammers have been designed. In the electric vehicle made by the Anderson Electric Car Company, Detroit, the roof is built of a single plate and each window sash is constructed of one piece, there being no joints to open up, swell or warp. Side panels, fenders and even hub caps on these cars are also made of aluminum.

High-Tension Disconnecting Switches

A simple method for sectionalizing high-tension lines is embodied in the disconnecting switch placed on the market by the K. P. F. Electric Company, 37 Stevenson Street, San Francisco, Cal.

Two disk or suspension-type insulators are mounted upon

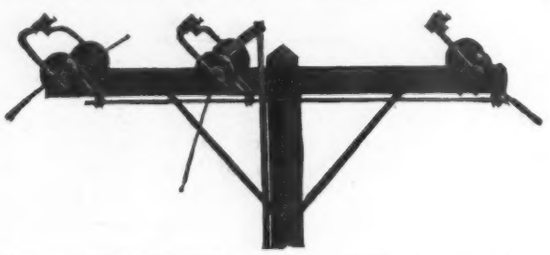
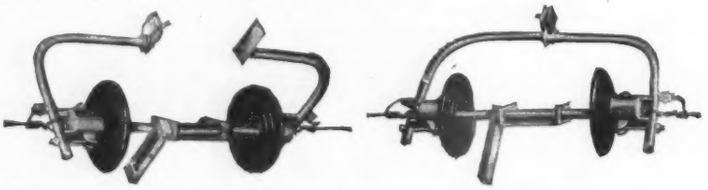


FIG. 1—DISCONNECTING SWITCH INSTALLED ON POLE

heavy iron pins, one of which is secured to a channel-iron base, while the other pin passes through the flanges of the channel through brass-bushed holes, a wrought-steel lever or crank being connected to the latter, providing means for its rotation. The channel iron base is drilled for two bolts by which it is secured to the cross-arm. The contact-carrying arms of galvanized-iron pipe are bolted to cast-iron caps which are cemented upon the heads of the insulators. The contact pieces consist of a pair of brass jaws or clips on the stationary arm and a blade on the movable arm.



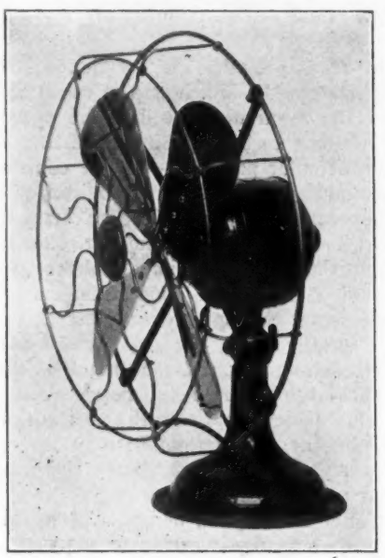
FIGS. 2 AND 3—SWITCH IN OPEN AND CLOSED POSITIONS

For a three-phase circuit three units are belted to the ordinary cross-arm in the pin positions. For opening the switch a wooden rod is attached to the steel lever previously mentioned and by using the pipe clamp as a fulcrum the contacts are pried apart.

The switch illustrated is designed for use on circuits operating at from 6600 volts to 22,000 volts.

Oscillating Fans

A feature of particular interest in the fan shown here is that the oscillating mechanism is entirely concealed within the rear-end cover. The horizontal over-all dimensions of the fan body are shortened by placing the detachable worm, which operates the oscillating mechanism, between the bearings instead of on a shaft extension beyond the rear bearing. The arc of oscillation may easily be changed while the fan is in motion by means of a knurled-head screw at the bottom of the oscillating disk which regulates the arc in four steps between 90 deg. and zero, at which point oscillation ceases. An automatic safety device has been adapted to the oscillating mechanism which causes oscilla-

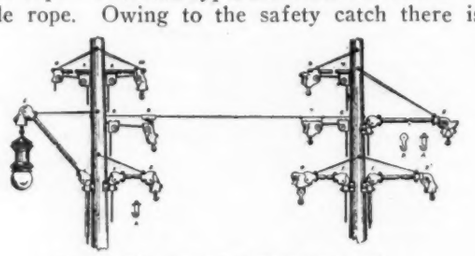


FAN WITH CONCEALED OSCILLATING MECHANISM

tory motion to cease temporarily if the fan body comes in contact with any obstructions which would tend to interfere with its swing. As soon as the obstruction is removed the fan at once starts its oscillatory motion. This fan has been developed for the market in several sizes for various services by the Diehl Manufacturing Company, Elizabethport, N. J.

Mast-Arm with Safety Catch

A mast-arm for arc lamps provided with a safety device of notable merit is now manufactured by Hickey & Schneider, 227 Fulton Street, New York. The rope for raising and lowering the lamp is inclosed in pipes in order to eliminate trouble from rain, sleet and snow and to increase the life of the rope. Different types are made for use of single or double rope. Owing to the safety catch there is no



MAST-ARM WITH SAFETY CATCH

strain on the rope after the lamp has been hoisted into place. The safety catch is said to be positive in action. Pulleys are installed in both knuckle and safety catch to facilitate the hoisting and decrease the wear on the rope. Some types of cast arms can be set at various angles so as to suit any conditions. Other types are designed always to be set level with the ground however the pole may lean.

Float-Type Recording Differential Pressure Gage

The float-type differential pressure recorder herewith illustrated has been developed by the Bristol Company, Waterbury, Conn. The construction and principle of operation of the instrument will be readily understood by referring to the sectional diagram, Fig. 2. There are two pressure chambers *A* and *B*, intercommunicating through

FIG. 1—FLOAT-TYPE RECORDING DIFFERENTIAL PRESSURE GAGE

the connection *C*. A cylindrical float *D* in the pressure casing *A* is connected by arms to the shaft *F*, which extends through the casing. The recording arm *G* is directly connected to the end of the shaft *F*.

Connections are made by means of the pipes *H* and *I* between the pressure chambers *A* and *B* and the two pressures the difference of which it is required to record. Mercury or water is employed in the pressure chambers according to whether the differential range to be recorded is high or low.

When the higher pressure is applied to the chamber *B* through the pipes *I* the level of the liquid in this chamber is lowered and that in the float chamber is raised,

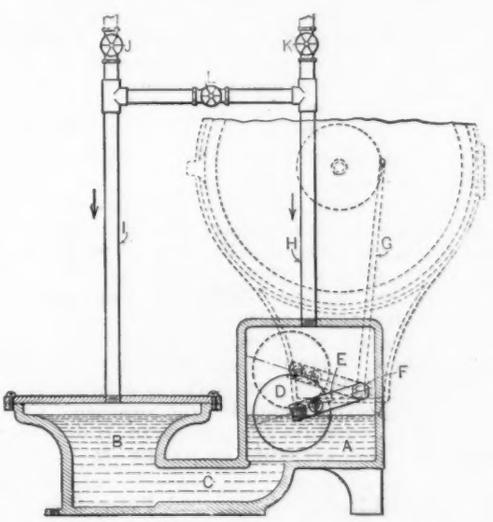


FIG. 2—SECTION OF RECORDING GAGE

thereby carrying the float and the attached recorder arm with it and making a record on a circular chart which is operated at the desired speed by making use of a clock mechanism.

By making the cross-sections of the pressure chamber *B* of certain proportions it is possible to produce a scale the graduations of which are uniform for equal increments of flow or volume. The Bristol-Durand radii-averaging instrument can therefore be used to determine the total flow or volume from the chart record of the instrument for a period of twenty-four hours.

As these gages will operate on extremely low differential ranges, they are particularly well adapted for use in connection with Pitot tubes for recording volumes of liquids, air or gases.

This instrument may also be used to record the head of water in tanks under varying pressures, as for instance height of water in steam boilers and condensers. Another special application is that of recording the flow of water through a notch or over a weir, even though liquid is under pressure or a vacuum.

Electric Range for Family Use

A new electric range suitable for the needs of a medium-sized family has recently been placed on the market by the Diamond Electric Company, Binghamton, N. Y. It has a flush steel top, 26 in. wide by 21.5 in. deep, with three hot

SMALL ELECTRIC RANGE

plates, two 8 in. and one 6 in. in diameter. The size of the oven is 20.5 in. by 17.5 in. by 12.5 in., it being large enough to take care of all the baking necessary for a medium-sized family.

The hot plates as well as the oven are equipped for three-heat control, the consumption of each device being as shown in the accompanying table. Each device is individually fused, all fuses being placed in the box to the right. It is rarely necessary to employ the "high" heat for the entire process of cooking or roasting, the "medium" or "low" heat being in almost all cases more desirable. The oven is made with a full glass door. The weight of the stove is 120 lb.

CONSUMPTION IN WATTS OF HEATING UNITS

	High	Medium	Low
Two 8-in. disk stoves (each)	1,500	750	375
One 6-in. disk stove	550	275	137
One electric oven	1,500	900	450

Industrial and Financial News

Public Utility, Commercial, Corporate and Trade Developments—The Electrical Material and Security Markets

Power Station for Maine Paper Mills.—Stone & Webster are building a large dam at Dundee Falls, near Newhall, Maine, from which electrical energy will be furnished to paper mills at Westbrook, 9 miles away.

Takes Up the Manufacture of Lighting Fixtures.—The Central Electric Company, Greensboro, N. C., jobber, has undertaken the manufacture of electric, gas and combination lighting fixtures. The products are known as Ceco fixtures.

Walpole Rubber Consolidates Its Boston Offices.—On May 24 the Walpole Tire & Rubber Company, Walpole, Mass., consolidated its various Boston offices at one location, 757 Boylston Street, where its general sales offices are now maintained.

Extending the Use of Telephone Dispatching.—The Missouri, Kansas & Texas system is equipping approximately 800 miles of its lines with telephone apparatus for dispatching trains. About 218 miles of the work is being done in Texas between San Antonio and Houston.

Motors for Railroad Shops.—The Texas & New Orleans Railroad Company has placed a contract with the Richmond Electric Works, Richmond, Va., for thirty induction motors, the total rating of which will be 600 hp. They will be used in the shops of the railroad company at Houston, Tex.

Hall Signal Company Expanding.—The Hall Signal Company has acquired the patent rights formerly owned by the General Railway Equipment Company, the United States Electric Signal Company and the Sandwich Electric Company. All of the equipment formerly handled by these companies will be made and sold by the Hall company.

Lowell Insulated Wire Company Doing Large Business.—The Lowell Insulated Wire Company, Lowell, Mass., states that it is making additions to its plant as rapidly as possible, and that in spite of the tariff and other pessimistic sentiment it has almost enough business on the books at the present time to keep the plant running day and night for a year.

New Plants on the Colorado River.—The Colorado River Power Company has filed water rights on a section of the Colorado River 40 miles north of Austin, Tex., where a large hydroelectric plant will be erected. The same interests are also planning to construct a dam on the Colorado River at Ballinger. This will cost about $1,000,000 and will be used chiefly for irrigation purposes.

Lansden Company to Move.—The Lansden Company, maker of electric vehicles, will move from Newark, N. J., to Allentown, Pa. A portion of the machinery and equipment of the plant is already on the way. A number of Allentown capitalists and investors are interested in the Lansden Company, and the new home of the company will be the plant of the Webb Company and the Mack Brothers Company.

Enters Electrical Supply Jobbing Field.—The Alter Light Company, 405 Desplaines Street, Chicago, which has been engaged in the manufacture of gas mantles for the past fifteen years under the direction of Jacob Alter, has broadened its field by becoming a jobber of electrical and gas supplies of all kinds. The manufacture of gas mantles will be continued, but no electrical equipment will be made. The company will move to a new factory within a month or so. The location of the latter has not been decided upon.

Hydroelectric Development in Italy.—A recent report on the industrial development of Italy shows that much of this has been along the lines of construction of hydroelectric plants for utilizing the immense water-power resources of the Alpine provinces. At present there are 7500 hydroelectric generating plants in Italy, aggregating more than 1,000,000 hp in rating. Transmission lines from these are being erected all over the country, as a result of which still further impetus will be given to industrial development in Italy.

Mica Imports Increased in 1912.—During 1912, according to the United States Geological Survey, the imports of unmanufactured and trimmed sheet mica into this country amounted to 1,989,132 lb., valued at $748,973, exceeding those of 1911 by 666,364 lb. in quantity and $246,810 in value. The total value of mica produced in the United States last year was $331,896, a decrease of $23,908 as compared with that in 1911. The production came from eight States—North Carolina, New Hampshire, Idaho, New Mexico, South Carolina, Colorado, South Dakota and New York—named in the order of the value of their output.

Mexico Northern Power Company Appeals to Great Britain for Protection.—On account of the threatened destruction of portions of the railroad between Santa Rosalia and Boquilla, Mexico, by the so-called revolutionists, an appeal has been made by the Mexico Northern Power Company to the British government for protection of its property. This railroad, which is about 40 miles long, is used for transporting material and supplies to the power company's construction camp at Boquilla, where a $6,000,000 dam is being built across the Conchos River. The railroad is owned by the same British syndicate that is constructing the dam.

New 12,000-kw Turbine for Toledo Station.—The Toledo Traction, Light & Power Company, which, as noted in these columns March 1, 1913, was in the market for a turbine unit, recently ordered from the General Electric Company a 12,000-kw, 25-cycle turbo-alternator set for its Water Street generating station. With the present extension to the power house there will also be installed four 680-hp boilers and a 250-ft. steel stack, besides a 1500-kw, 60/25-cycle frequency-changer set and a 1500-kw motor-generator set for the Edison downtown network. Encircling the boundaries of the city, the company is also erecting a 33,000-volt belt transmission line, 34 miles long, to supply energy to outlying factories. The circuit will be carried on steel towers.

Electrical Contracting Work in Chicago.—Henry Newgard & Company, electrical contractors in Chicago, recently completed the electrical installation in the new Chicago, Burlington & Quincy office building at South Clinton Street and West Jackson Boulevard. Some of the contracts which are being executed at present by Newgard & Company are for the electrical equipment of the Consumers' Building, at South State and Quincy Streets; the Kiper Building, at West Van Buren and South Sangamon Streets, and industrial plants for the Beardslee Chandelier Manufacturing Company, the American Hide & Leather Company and the Franklin Engraving & Electrotyping Company.

Will Deal in Electric-Railway and Power-Station Materials.—The Drew Electric & Manufacturing Company, 714 Traction Terminal Building, Indianapolis, which was incorporated in April, has taken over the electric-railway material department of the Indianapolis Brass Company, of which James H. Drew, president and organizer of the Drew company, was secretary and treasurer for the past six years. All of the materials, patents, patterns, trade designs, trade-marks, good will, etc., pertaining to the electric-railway business formerly carried on by the Indianapolis Brass Company have been taken over by the new company. The latter is now doing business, is enlarg-

ing its manufacturing facilities and expects to carry a full line of electrical equipment.

Norfolk (Va.) Jobber to Have New Offices.—The Atlantic Electric Company, Norfolk, Va., jobber, will move on or about Oct. 1 from its present location, 85 Commerce Street, to a new building which is being erected for it on Granby Street, the main retail thoroughfare of the city. The entire building, which will be 20 ft. by 100 ft. and three stories high, will be occupied by the Atlantic company. The first floor will have a showroom in front devoted exclusively to the display of electric household appliances. The rear will be used as a receiving and shipping room, while the offices will be on the mezzanine tier. The second and third floors will be used as stockrooms. Arrangements are being provided so that manufacturers desiring to exhibit or demonstrate their lines will be furnished with every facility.

Call for Century Motors Abroad.—R. J. Russell, of the Century Electric Company, St. Louis, Mo., writes optimistically of the present conditions and immediate outlook in that company's business. He says in part: "The demand for Century single-phase motors is constantly increasing not only for the United States but for foreign consumption as well. We can see nothing on the business horizon at this time that would indicate that we might expect any other than a very active demand in all lines of the electrical industry for at least the next three or four months, beyond which time it is not safe to prophesy in a definite manner. We are building an eight-story reinforced-concrete building as an addition to our present factory, in hope that we shall be able to do away with the night force that we have had at work for more than a year. This new building will practically double our floor space."

Pacific Gas & Electric Resumes Work on New Stations.—The Pacific Gas & Electric Company has resumed work on the Lake Spaulding dam and power houses, construction of which was interrupted by the winter weather. More than 1000 yd. of concrete a day is now being poured at the dam. The tunnel leading from the dam to the power house is practically completed, some work having been done upon it during the winter. The Bear River canal is half finished, the steel is up for the power house, and its equipment will begin to arrive within thirty days. Two of the power houses further down the stream have been started. Work on four tunnels has begun, two dams are in process of construction, and two more will be started within a short time. Work on a third power house will be started in the fall. The company has applied to the California Railroad Commission for authority to issue $5,000,000 of convertible debentures, which, if issued, will bring the total bonded debt up to $80,858,000.

Big Station for Canadian Paper Mills.—The Laurentide Pulp Company is planning to make large extensions to its plant at Grand-Mère, Quebec, to cost approximately $1,000,000. One of the most interesting features from the viewpoint of electrical engineers will be the building of a large new power house capable of developing 65,000 hp. Application has been made to the Department of Public Works for permission to construct a dam across the St. Maurice River at Grand-Mère. In the official application permission is asked for the right to use all the water-power of the river at Grand-Mère, with the exception of such as may be used for sluicing logs over the proposed dam. The dam is to be of concrete with sluicegates and a spillway 1900 ft. long. The power house will have eight main power units with space for two more units when required. It is understood that the application will come before the Cabinet council in the course of a few days and will be granted. Contracts for the waterwheels to be used in this station were awarded recently to the I. P. Morris Company, Philadelphia.

German Equipment for Largest Chilean Power Plant.—The largest electrical power plant of its kind in South America is about to be built for the Chile Exploration Company by the Siemens-Schuckertwerke, G.m.b.H., of Berlin. The contract for this important project has just been placed with the New York office of that concern. This contract includes a generating plant on the Chilean coast and a substation at a distance of about 130 miles from the mines of the Chile Exploration Company. The power plant proper, which will have a rating of 40,000 kva, will consist of four 10,000-kva, three-phase Siemens-Schuckert turbogenerators coupled with turbines furnished by Escher, Wyss & Company, Zurich. Current will be generated at 5000 volts, and the latter will be stepped up to 110,000 volts by four 10,000-kva transformers and transmitted over a 130-mile transmission line to the substation, where it will be stepped down to 5000 volts by four 10,000-kva transformers. The substation will contain seven motor-generator sets. Of these there will be three synchronous motor-generators of 2500 kw each and four induction motor-generator sets of the same size. Each of the motors is to be direct-connected to two 1250-kw, 5000-amp, 250-volt direct-current generators. The power plant, as well as the substation, will be delivered by the Siemens-Schuckertwerke, G.m.b.H., complete in every respect, including buildings and foundations. The transmission line proper will be built by the Chile Exploration Company. The mining station is located at an altitude of about 10,000 ft. The high-tension side of all apparatus and machinery at the substation and also the greater part of the transmision line will be insulated for a voltage of 150,000 volts under ordinary conditions.

Imports of Electrical Machinery by Japan.—Consul-General Sammons, Yokohama, made the following statement recently concerning the importation of machinery by Japan: "Japan is buying a steadily increasing amount of foreign machinery and engines, the total for 1912 aggregating $14,175,989. During the past three years the sale of products of this kind that were manufactured in the United States nearly doubled, the increase being upward of $1,300,000. Nevertheless, it is well known among the expert representatives of the various competing companies that in some lines—particularly in cement and paper-making machinery—European manufacturers have recently been securing orders that were actively solicited by American concerns. In other lines, however, the American manufacturers have steadily increased their exports, as is shown by the fact that their total sales to Japan in 1912 amounted to $3,442,324, as compared with $3,144,499 in 1911. The total importations of machinery and engines into Japan for 1912 may be summarized as follows: Imported from the United States, $3,442,324; from Belgium, $66,533; from Germany, $3,214,770; from Great Britain, $7,104,011, and from other countries, $348,342, making a total of $14,175,989. Of generators, motors and transformers nearly 50 per cent of Japan's total imports in 1912 came from the United States. The competition in this particular line has been decidedly brisk. A summary of the results of the past three years is as follows: Imported from the United States in 1910, 1911 and 1912, $449,256, $901,974 and $712,060; from Germany, $315,932, $1,372,046 and $535,893; from Great Britain, $304,236, $538,219 and $338,164; from other countries, $22,153, $31,937 and $6,763—the totals for these three years being $1,091,577, $2,844,176 and $1,592,880."

Electrical Instrument Makers Rushed with Orders.—The Duncan Electric Manufacturing Company, Lafayette, Ind., states that its business in direct-current watt-hour meters has grown to such proportions that for over seven months it has been obliged to operate its plant until 9 o'clock for five nights a week and is still behind on its orders. On this account the company found it necessary to double its factory space. Work was commenced several weeks ago upon a new building which is to be four stories high and of the most modern construction. Every modern feature along the lines of individual motor drive and efficient lighting, heating and ventilating systems has been embodied in the design of the new plant. There will be a large fireproof vault in the basement of the building to safeguard such small tools as punches, dies and jigs, while to facilitate the handling of large tools a small industrial railway will be built. In addition to this new factory building, there is also being built a new testing laboratory which will be equipped with motor-generators, storage batteries and a complete line of modern standardizing instruments. This building will be of reinforced concrete, one story high, with saw-tooth roof, and will have a floor area of 15,000 sq. ft. The entire plant is to be furnished with an automatic sprinkler system and the vacuum system of heating. All

of the oil and gasoline used in the machine shops, the dip-room and the blacksmith-shop furnaces is to be fed from a central source by compressed air. To increase the motive power of the plant a second 150 Sterling boiler has been purchased, and to safeguard against break-downs, a 100-hp, three-phase motor, to operate upon the central-station service, will be installed and held in reserve. Besides these additions to its manufacturing facilities, the company has been making plans for enlarging its sales force. Within a few weeks it will have agents in twenty of the largest cities in the country, including those which have represented it at Boston, New York and Chicago for many years. Owing to the introduction of a considerable amount of automatic machinery and extensive improvements in its manufacturing methods, the Duncan company made a substantial reduction in the price of its watt-hour meters on May 1, as a result of which a material increase has taken place in the volume of its business.

May Build Diesel Engines in This Country.—Charles A. Carels, senior member and chairman of the board of directors of Carels Frères of Ghent, Belgium, builders of Diesel engines, has just arrived in New York. Mr. Carels has come to America to confer with the company's United States representative, W. R. Haynie, 30 Church Street, New York, upon the advisability of building Diesel engines in the United States and will be in this country for several weeks. During this time he will make an extended trip, covering the important industrial centers, and will visit some of the country's large manufacturing plants, particularly the more prominent tool works. Among the latter the plants of Lodge & Shipley, of Cincinnati, and the Niles-Bement-Pond Company, who, as a matter of interest, furnished a large part of the tools in the works of Carels Frères, will be visited. American methods are used to a great extent in the Ghent plant, of which the superintendent is D. G. Baker, an American engineer.

Bakelite Patent Recognition.—The General Bakelite Company has issued the following statement: "As a result of negotiations between the General Bakelite Company and the Condensite Company of America, the suits brought by the former against the latter and its customers for alleged infringement of the Bakelite patents have been withdrawn, and the Condensite company, recognizing the pioneer character of Dr. L. H. Baekeland's work, has acknowledged the validity of the Bakelite patents in suit and some others and will pay substantial royalties thereunder. The General Bakelite Company will continue the manufacture of bakelite under its numerous patents, and the Condensite company will manufacture condensite under the Aylsworth patents, as well as under the license just granted for such of the Baekeland patents as are broad enough to cover condensite. This recognition of the force and validity of the principal Baekeland patents by the only other manufacturer of condensation products is a confirmation of the Bakelite company's claims for the broad scope and pioneer character of these patents. There is much that is old in the art of making phenolic condensation products, but Dr. Baekeland was the first to make practical application of what theretofore had been chiefly laboratory experiments."

Marshall Field & Company's Great Fleet of Electric Vehicles.—One of the largest users of electric vehicles in the United States—possibly the largest—is the establishment of Marshall Field & Company, general merchants, of Chicago. This great concern, with its wholesale and retail departments, has about 150 electric delivery wagons and trucks in service and has ordered 50 more, so that by the end of this year its fleet will consist of 200 vehicles. The electrics now in use represent an investment of about $750,000. All were made by the Walker Vehicle Company. Marshall Field & Company have seven garages, with a total rating in battery-charging equipment of about 1500 kw. They have just finished a garage at Forty-seventh Avenue and West Lake Street with a rating of 150 kw. A contract has now been signed for a similar equipment in the garage at Montrose Boulevard and Ravenswood Park. These garages are supplied with alternating current and equipped with motor-generators. In addition, Marshall Field & Company are adding 600 kw in equipment to the large downtown direct-current garage at the corner of South La Salle and West Van Buren Streets. Electricity is purchased for all garages from the Commonwealth Edison Company. Frederick J. Pearson is the consulting engineer for Marshall Field & Company.

Ohio Lighting Company Sold.—The property of the Bellevue (Ohio) Light & Power Company has been purchased by the Lake Shore Electric Railway Company, of Cleveland. The latter will close down the generating station formerly operated by the Bellevue company and furnish energy to that community from its own station.

Ottawa Company to Improve Its System.—The directors of the Ottawa Light, Heat & Power Company, Ottawa, Canada, have authorized an increase of $800,000 in the capital stock of that company. The proceeds will be used for additions and improvements to the system.

Pennsylvania Telephone Company Will Be Reorganized.—A plan for the reorganization of the Consolidated Telephone Companies of Pennsylvania has been formulated by a bondholders' committee. This company owns and operates the Lackawanna Telephone Company, Scranton; the People's Telephone Company, Wilkes-Barre; the Lehigh Telephone Company, Allentown; the Honesdale Telephone Company and the Berwick Telephone Company.

National Telephone Company Sold.—The National Telephone Corporation of West Virginia has been sold to an Eastern syndicate and its holdings will be split into three new companies in Ohio. The properties controlled by the National corporation were the Pittsburgh & Allegheny Telephone Company, the National Telephone Company of West Virginia, the National Telephone Company of Ohio, the National Telephone Company of Pennsylvania, the National Telephone Company of Monongahela County, the West Virginia Western Telephone Company, the Consolidated Telephone Company, the Union Telephone Company, the Woodfield Telephone Company, the Chartiers Telephone Company, the Pittsburgh & Wheeling Telephone Company, the Beeghler Telephone Company and the Western Central Telephone Company. The syndicate will pay $1,000,000 for the assets.

Industrial Securities

Security	Capital Stock Listed	DIVIDEND		QUOTATION	
		Per Cent	Period	May 21	May 26
Allis-Chalmers, t.r., 5th pd	$19,800,000	.....	.....	7¼	7¼
Allis-Chal., pf.,t.r.,5th pd..	16,050,000	.....	.....	15½*	15½*
Amalgamated Copper.....	153,887,900	1½	Q	73¼	74¼
American Tel. & Tel.....	344,471,400	2	Q	128¼	129¼
Electric Storage Battery,c.	16,074,425	1	Q	47¼	47¼
General Electric.....	101,363,600	2	Q	138¼	139¼
Mackay Cos., c.....	41,380,400	1½	Q	82*	82
Mackay Cos., pf.....	50,000,000	1	Q	68*	67½*
Western Union Tel.....	99,747,600	¾	Q	65½*	65½
Westinghouse, E. & M., c.	34,496,400	1	Q	62	62¼
Westinghouse, E. & M., pf.	3,998,700	1¾	Q	114*	114*

*Last price quoted.

NEW YORK METAL MARKET PRICES

	May 20 Bid.	May 20 Asked.	May 26 Bid.	May 26 Asked.
Copper:				
Standard, spot.....	.....	15.37½	.....	15.37½
	£ s d		£ s d	
London, standard, spot.....	69 18 9		68 12 6	
Prime Lake.....	15.70	to 15.80	15.65	to 15.75
Electrolytic	15.55	to 15.65	15.55	to 15.65
Casting	15.40	to 15.50	15.40	to 15.50
Copper wire, base.....	17.00		17.00	
Lead	4.35		4.35	
Nickel	40.00	to 45.00	40.00	to 45.00
Sheet zinc, f. o. b. smelter.....	7.50		7.50	
Spelter, spot.....	5.45	to 5.55	5.40	to 5.45
Tin, spot.....	47.62½		48.20	
Aluminum:				
Prompt delivery.....	25.00	to 26.00	25.00	to 25.50
Future	25.25	to 26.25	25.25	to 26.25

OLD METALS

Heavy copper and wire.....	14.87½	14.87½
Brass, heavy..	9.37½	9.37½
Brass, light.....	8.50	8.50
Lead, heavy.....	4.25	4.25
Zinc scrap.....	4.50	4.50

COPPER EXPORTS IN MAY

Total tons to May 27.....	31,617

Personal

Mr. B. F. Wellington, Jr., has been appointed assistant Pacific Coast manager for H. M. Byllesby & Company.

Mr. Carl Felker has been appointed assistant contract agent of the Toledo (Ohio) Railways & Light Company.

Mr. C. A. Dow will assume the position of superintendent of the water and light department of the city of Alliance, Neb., on June 1.

Mr. H. M. Jones has resigned as manager of the Lewiston (Idaho) branch of the Pacific Power & Light Company of Portland, Ore.

Mr. William W. S. Butler, vice-president and general manager of the Western States Gas & Electric Company of California, Stockton, Cal., since its formation, has resigned.

Mr. E. T. Scholer has been appointed manager of the electric light station at Nezperce, which was recently acquired by the Grangeville (Idaho) Electric Light & Power Company, Ltd.

Mr. C. E. Murray has been appointed secretary and auditor of the Toledo (Ohio) Railways & Light Company. Mr. Murray was formerly associated with the Doherty interests at Joplin, Mo.

Mr. Thomas F. Kelly, sales manager of the Dayton (Ohio) Power & Light Company, has been appointed a member of the publicity committee of the Chamber of Commerce for that city.

Mr. Howard Murray, of the Shawinigan Water & Power Company, Montreal, Quebec, has been nominated as the new president of the Montreal branch of the Canadian Manufacturers' Association.

Mr. W. M. Wood has been appointed manager of the Lewiston (Idaho) branch of the Pacific Power & Light Company, of Portland, Ore. He was formerly in charge of the company's Sunnyside office.

Mr. Robert M. Searle, vice-president of the Rochester (N. Y.) Railway & Light Company, sailed from New York on May 27 for a ten weeks' automobile tour through Germany, France, Switzerland and Italy.

Mr. E. M. Raver, superintendent of transportation for the Michigan United Traction Company at Battle Creek, Mich., has resigned and accepted a position with the Lincoln (Neb.) Railway & Power Company.

Mr. J. P. Moore, formerly with the Westinghouse Electric & Manufacturing Company, has been made superintendent of power and equipment of the People's Incandescent Light Company of Meadville, Pa.

Mr. F. W. Hallin has been elected vice-president and general superintendent of the Arkansas Public Service Company, Little Rock, Ark., a corporation engaged in light and water service in several towns in the State.

Mr. S. J. Kehoe, superintendent of the Norwich & Westerly Traction Company of Norwich, Conn., has tendered his resignation, effective June 1, and accepted the post of superintendent of the Norwich (Conn.) Gas & Electric Company.

Mr. Warren C. Earle, who has been with similar boards in several states and in practical work with several railroads in the United States, has been appointed chief engineer of the California State Railroad Commission, vice Mr. R. A. Thompson, resigned.

Mr. Hugh L. Cooper, vice-president and chief engineer of the Mississippi River Power Company, Keokuk, Ia., plans to sail in July for a six months' vacation and tour of Europe, following the completion of construction work on the great water-power plant at Keokuk.

Mr. Samuel Kahn, who has been assistant Pacific Coast manager for H. M. Byllesby & Company, Chicago, has been appointed general manager of the Western States Gas & Electric Company of California, Stockton, Cal., as successor to Mr. William W. S. Butler, resigned.

Mr. R. A. Thompson, chief engineer of the California State Railroad Commission, has resigned his position to accept a position on the advisory valuation board of the Interstate Commerce Commission just formed to undertake the valuation of the railroads of the United States.

Mr. F. W. Willcox, for many years connected with the Harrison Lamp Works of the General Electric Company and now with the British Thomson-Houston Company, London, England, is on a visit to this country. Mr. Willcox will return to England next month, leaving New York on June 14.

Mr. F. J. Derge has been appointed manager of light, heat and power for the Toledo (Ohio) Railways & Light Company. Mr. Derge was until his removal to Toledo a member of the New York staff of H. L. Doherty & Company, who recently acquired the major portion of the Toledo company's stock.

Mr. Albert Frank Horton, who opened the "Electric Shop" for the Comomnwealth Edison Company, Chicago, has become associated with the Consolidated Gas. Electric Light & Power Company of Baltimore, for which company he is arranging an operating display of domestic devices in the form of an "electric house."

Mr. Arthur Williams, of the New York Edison Company, will sail for Europe on the S.S. *France* on June 5. Mr. Williams will visit Ghent, Paris, Berlin and Munich. He will also spend some time in London and other parts of England. In addition he will pay his respects to the King of Spain, who recently decorated him with the cross of the Royal Order of Isabela la Catolica.

Mr. Frank Howard, of Scranton, Pa., has recently been appointed assistant superintendent of the Wheeling (W. Va.) Electric Company, which is controlled by the American Gas & Electric Company. For the past four years Mr. Howard has been superintendent of distribution of the Scranton Electric Company. He was manager and superintendent of the companies controlled by J. B. Russell & Company prior to joining the Scranton forces.

Mr. John R. Wilde has been appointed chief engineer of power plants for the Detroit Edison Company, succeeding Mr. B. J. Denman, who resigned May 1 to take up executive duties with the United Light & Railways Company at Davenport, Ia. Mr. Wilde has been in the service of the Detroit company for a number of years. Mr. J. W. Parker has also been appointed chief assistant engineer of power plants, sharing with Mr. Wilde the duties formerly discharged by Mr. Denman.

Mr. H. L. Patterson, who as first vice-president succeeded to the presidency of the Ohio Society of Mechanical, Electrical and Steam Engineers, following the death, April 17, of President E. M. Adams, chief engineer for the Quaker Oats Company, Akron, Ohio, is general manager of the Pennsylvania China Company, Ford City, Pa., manufacturer of porcelain insulators. Mr. Patterson was until recently in the operating field in Ohio, having served for a number of years as general manager of the Mahoning & Shenango Railway & Light Company of Youngstown.

Mr. F. E. Bowman, who, as announced in the May 17 issue, was elected president of the Gas, Electric & Street Railway Association of Oklahoma at the meeting held in Oklahoma City on May 6-8, is vice-president, treasurer and manager of the Ada (Okla.) Electric & Gas Company. Mr. Bowman was born in Wooster, Ohio, and entered the electrical field in 1892 as bookkeeper and cashier with the Huntington (Ind.) Light & Fuel Company, which generated electricity and produced artificial gas, natural gas and petroleum. He advanced through various positions with the company to the office of treasurer. Five years ago he resigned from the Huntington Light & Fuel Company to accept his present position as vice-president, treasurer and manager of the Ada Electric & Gas Company. The company with which Mr. Bowman is now connected serves Ada, which has a population of 6000, and the surrounding territory.

F. E. BOWMAN

Construction

New England

CAMDEN, MAINE.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until July 1, for construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring and interior lighting fixtures, hydraulic mail lift and approaches, of the United States post office at Camden, Maine. Plans and specifications may be obtained at the above office or from the custodian of site, at Camden, Maine. O. Wenderoth is supervising architect.

GRANITEVILLE, VT.—The Consolidated Ltg. Co., of Montpelier, expects to erect a new substation at the end of its 13,200-volt transmission line at Graniteville. The building will be built of brick and will be equipped for an output of 2700 kw, which will include transformers and new switching equipment. This substation will distribute electricity to the granite quarries in this vicinity and also for general lighting and heating service to the surrounding territory. Contracts for the purchase of all material will be handled from the office of Charles H. Tenney & Co., 201 Devonshire Street, Boston, Mass., who will also take charge of the work. H. D. Larrabee, of Montpelier, is manager.

CAMBRIDGE, MASS.—The Cambridge Gas, El. Lt. & Pwr. Co. expects to erect within the next six months a 12,000-volt, three-phase transmission line, 18 miles long, and to purchase substation equipment, including switchboard, transformers, poles, insulators, one tub transformer, lamps, etc., and a few general supplies with the next six months. G. Lobo is secretary and treasurer.

Middle Atlantic

BROOKLYN, N. Y.—Commissioner George V. S. Williams of the Public Service has authorized the engineering staff to investigate a plan by which the two power houses to be located at the foot of Clark and Montague Streets, to be used in connection with the proposed tunnels under the river, may be operated by electricity.

BROOKLYN, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, Department of Education, corner of Park Avenue and Fifty-ninth Street, New York, N. Y., until June 2, for installing heating and ventilating apparatus, temperature regulators and elevators in the Bay Ridge High School, located on Fourth Avenue, at Sixty-seventh Street; also for installing electric ash hoist in the Boys' High School, on Marcy Avenue, between Madison Street and Putnam Avenue.

BUFFALO, N. Y.—Bids will be received by the Commissioner of Public Works, Room 5, Municipal Building, Buffalo, until June 3, for miscellaneous annual contract work to be performed and supplies to be delivered at the various school buildings and annexes, police and fire department buildings and other buildings under the control of the Department of Public Works, including keeping in repair the electric bell and telephone systems in the various school buildings and annexes, from Aug. 1, 1913, to July 31, 1914. Plans and specifications are on file and may be examined at the office of the deputy building commissioner, Room 6, Municipal Building, where blank form of proposals may be secured. Francis G. Ward is commissioner of public works.

BUFFALO, N. Y.—Bids will be received by the commissioner of public works, Room 5, Municipal Building, Buffalo, until June 4 for the construction of a new four-room addition to the present school building in District No. 7, located on Bailey Avenue, near Clinton Street. A separate and distinct proposal must be submitted on the following divisions: (a) Masonry, cut stone, iron work, plastering, etc.; (b) carpentry, painting, glazing, hardware, etc.; (c) roofing, sheet-metal work, steel ceilings, etc.; (d) electric wiring, lighting fixtures, etc.; (e) heating, radiation, etc.; (f) plumbing, gasfitting, etc. Plans and specifications may be seen at the office of the deputy building commissioner, Room 6, Municipal Building. Francis G. Ward is commissioner of public works.

BUFFALO, N. Y.—Bids will be received by the commissioner of public works, Room 6, Municipal Building, Buffalo, until June 5 for construction of a two-story firehouse, to be known as engine-house No. 36 and to be located at the corner of Elmwood and Great Arrow Avenues. A separate and distinct proposal must be made for the following divisions of the work: (a) Masonry, cut stone, iron work, fireproofing, plastering, etc.; (b) carpentry, painting, glazing, hardware, etc.; (c) roofing, sheet-metal work, steel ceilings, etc.; (d) electric wiring, lighting fixtures, etc.; (e) heating, ventilating, radiation, etc.; (f) plumbing, drainage, gasfitting, etc. Plans and specifications may be seen at the office of the deputy building commissioner, Room 6, Municipal Building, where blank forms of proposals may be secured.

NEW YORK, N. Y.—Bids will be received by George McAneny, president of the borough of Manhattan, at the offices of the commissioner of public works, Room 1808, 21 Park Row, New York, until June 4, for furnishing and installing an electric elevator in the County Court House, Chambers Street, City Hall Park. Blank forms, specifications and plans may be seen at the office of the auditor and offices of the commissioner of public works, Room 1808, 21 Park Row, New York.

NEW YORK, N. Y.—Bids will be received by the Board of Water Supply, 165 Broadway, New York, N. Y., until June 10 (contract 93) for the construction of a complete telephone transmission line, approximately 65 miles long, along the Catskill Aqueduct, between the Ashokan reservoir, in Ulster County, and the Croton reservoir, in Westchester County, the work to include a submarine crossing at the Hudson River. Pamphlets containing information for bidders, forms of proposal, contract, specifications, etc., may be obtained at the above address upon application, for which a deposit of $10 will be required for each pamphlet, to be refunded upon return of same. Joseph P. Morrisey is secretary of board.

PORT JEFFERSON, N. Y.—The Port Jefferson El. Lt. Co. expects to purchase a few 500-watt Mazda lamp fixtures for street lighting. W. T. Wheeler is secretary and manager.

AKRON, PA.—The Akron El. Lt. & Pwr. Co., the Warwick El. Lt. & Pwr. Co., the West Earl El. Lt. & Pwr. Co. and the Ephrata El. Lt. & Pwr. Co., which were recently granted charters, have been consolidated under the name of the Akron El. Lt. & Pwr. Co. with a capital stock of $40,000. H. Z. Bitner is president of the company and A. N. Wolf secretary and treasurer.

ASHLAND, PA.—The Lehigh Coal & Navigation Co., of Lansford, Pa., has purchased the property of the Edison El. Illuminating Co. at Ashland for $70,000. This is the beginning of a general consolidation of electric plants in this part of the State to be supplied with power from the new plant of the Lehigh Coal & Navigation Co.'s plant at Hauto.

CONNELLSVILLE, PA.—Application has been made to the City Council by J. George Kaelber, of Rochester, for a franchise for the Connellsville Pub. Utility Co., which will be capitalized at $500,000. The company proposes to furnish electricity, steam heat and hot water in Connellsville.

ERIE, PA.—The City Council has adopted an ordinance whereby the gas lamps now in use will be replaced with electric incandescent lamps. The Erie County El. Co. has the contract for substituting the lamps.

HARRISBURG, PA.—Charters have been granted by the State Department for the following companies: The Eddington El. Co., of Bristol; the West Caln Co., of Philadelphia; the Township of Bensalem Lt. & Pwr. Co., of Bristol; the Stoneboro Pwr. Co., of Stoneboro, and the Sandy Lake Pwr. Co., of Sandy Lake. Each company is capitalized at $5,000.

PHILADELPHIA, PA.—Plans and specifications have been completed for a new power house to be erected for E. F. Houghton & Co. at 240 West Somerset Street.

PHILADELPHIA, PA.—A permit has been granted the William Steele & Sons Co. for the erection of a power house (85 ft. by 79 ft.) to be located at Blabon Street and the Reading Railway, for the George W. Blabon Co., to cost $20,000.

PITTSBURGH, PA.—Bids will be received at the office of the secretary of Board of Public Education, Pittsburgh, Pa., until June 2 for furnishing operating supplies, including electrical, steam-fitting, carpenter supplies, etc. Bidding blanks and specifications will be furnished upon application to the superintendent of supplies, 703 Fulton Building, Pittsburgh. George W. Gerwig is secretary of board.

EAST ORANGE, N. J.—The finance committee of the City Council has decided to recommend a bond issue of $20,000 for extension to the police call-box system, to cost about $10,000, and to install a signal system at a cost of from $6,000 to $9,000.

JERSEY CITY, N. J.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 16 for one electric elevator and one hydraulic lift in the United States post office at Jersey City, N. J., in accordance with plans and specifications, copies of which may be secured at the above office. O. Wenderoth is supervising architect.

BRUNSWICK, MD.—The Harper's Ferry El. Lt. & Pwr. Co., of Harper's Ferry, contemplates furnishing electrical service in Brunswick and proposes to build a power station here.

BERKELEY SPRINGS, W. VA.—The Northern Virginia El. & Pwr. Co., which recently purchased the property of the Cacapon Pwr. Co., of Berkeley Springs, contemplates the erection of an overhead transmission line between Martinsburg and Berkeley Springs. J. J. Lumley, of Winchester, Va., superintendent, will have charge of the work.

BEDFORD CITY, VA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 28 for construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring and interior lighting fixtures and approaches, of the United States post office at Bedford City, Va. Drawings and specifications may be obtained from the custodian of site at Bedford City or from the above office. O. Wenderoth is supervising architect.

BROADWAY, VA.—The proposition to issue $25,000 in bonds for the construction of an electric-light plant will be submitted to the voters.

CLIFTON FORGE, VA.—The Virginia-Western Pwr. Co., recently incorporated with a capital stock of $626,000 and a bond issue of $1,500,000, contemplates the erection of a transmission line from Clifton Forge to Lexington and enlargement of its present steam plant at Clifton Forge, together with a hydroelectric plant in this vicinity. The company is to take over and consolidate the properties of the Virginia-Western El. Co. of Clifton Forge, the Covington Lt. & Pwr. Co. of Covington, and the Buena Vista Lt. & Pwr. Co. of Buena Vista, Va. W. G. Mathews is president of the company and A. C. Ford secretary and treasurer.

GRUNDY, VA.—A company, it is stated, has been organized to install and operate electric-light, ice and water plants in Grundy. E. E. Smith is interested in the project.

WASHINGTON, D. C.—Bids will be received by the Department of the Interior, Washington, D. C., until June 5 for furnishing and installing one 350-kw generator and engine, installation of water-tube boiler and mechanical stoker and for relocating, extending and connecting switchboard in engine room, old post office building, Eighth and E Streets, N. W., Washington, in accordance with plans and specifications, copies of which may be obtained on application to the chief clerk of the department. Award of contract will be made subject to appropriation by Congress to meet the expense of the work. Lewis C. Laylin is assistant secretary.

WASHINGTON, D. C.—Bids will be received at the office of the chief signal officer, War Department, Washington, D. C., until June 9, for furnishing the following supplies under proposal No. 656: (1) 25 scissors for inspectors' pocket kits, 5-in., nickeled, J. Wiss & Son or equal; (2) 50 strap sets with pads, for Klein's Eastern climbers (best quality, four to a set); (3) 100 side-cutting 6-in. pliers, U. D. F. & T. Co. No. 50 or equal; (4) 200 side-cutting 8-in. pliers, U. D. F. & T. Co. No. 50 or equal; (5) 50,000 Milonite tacks, No. 19, drab; (6) 75 tweezers for pocket kit, 4½ in., nickeled; (7) 250 inspectors' pocket kits, specification 186-D; (8) 100 outlet boxes, circular type, without plugs; (9) 300 sleeve-splicing boxes, for one-pair armored cable; (10) 100 Faraday 100-ohm buzzers; (11) 25 armor cable cutters, No. 312; (12) 360 fuses, Cook type A-7, 5-amp; (13) 100 plugs for target range outlet boxes; (14) 150 lb. rubber tape; (15) 1900 lb. friction tape; (16) 5000 12-in. oak brackets; (17) 200 buzzer connectors, model A; (18) 350 wire pikes, complete with hickory handles; (19) 250 ground-iron rods, ⅝ in. by 5 ft., galvanizing in accordance with specification 96-C, with copper annealed connecting wire wound about and soldered to upper end; (20) 200 combination tips for lance poles, specification 560; (21) 45 pocket telegraph relays, 150 ohm with leather case; (22) 15 oak plugs; (23) 15 umbrella insulators; (24) 15 electrose insulators, No. 2; (25) 21 Manhattan El. Co.'s connectors No. 6540. Major W. L. Clarke is disbursing officer.

North Central

ADRIAN, MICH.—The town of Adrian expects to purchase within the next four weeks a horizontal tubular boiler (72 in. by 18 ft.) for the municipal electric-light plant. T. W. Newell is superintendent.

ALBION, MICH.—The city lighting commission has recommended that the city renew its contract with the Commonwealth Pwr. Co., of Jackson, for ten years in preference to issuing bonds for the installation of a municipal electric-light plant. The committee also recommends that a system of ornamental lamps (three-lamp clusters) be erected in the business section and a low-voltage system for the residence sections with tungsten lamps at every street corner.

BIG RAPIDS, MICH.—The Big Rapids El. Co. has granted the Big Rapids Wtr. Pwr. Co. permission to erect a central plant west and adjoining its power house. It is understood that the water-power company contemplates generating its own energy. H. J. Emmons is engineer for the water-power company.

DETROIT, MICH.—Frank H. Misterky, superintendent of the municipal electric-light plant, announces that bids will be opened June 10 for a new 5000-kw, 60-cycle, two-phase, 2200-volt turbine alternator of the horizontal type, together with condensing equipment. The public lighting commission also plans to purchase shortly 1000 new luminous-arc lamps. It recently installed 50 inverted boulevard lamps on local park drives and will increase the number to 150.

GRAND RAPIDS, MICH.—The Grand Rapids-Muskegon Pwr. Co. will soon install lighting systems in Casnovia, Bailey and Grant.

OVID, MICH.—At a special election held May 19 the proposition to issue $6,000 in bonds for improvements to the municipal electric-light plant was carried.

PONTIAC, MICH.—The lighting commissioner has authorized the Pontiac Pwr. Co. to install 16 new street lamps at once.

BELLEVUE, OHIO.—The Lake Shore El. Ry. Co. has purchased the plant and lighting franchise of the Bellevue Illuminating & Pwr. Co. and has taken possession of same.

CLEVELAND, OHIO.—Bids will be received at the office of W. H. Kirby, secretary to the director of public service, No. 104, City Hall, Cleveland, until June 3 for steam engine and generator for the Collinwood station of the municipal electric-light plant, specifications for which may be obtained at the office of the engineer of construction, Room 319, City Hall. W. J. Springborn is director of public service.

CLEVELAND, OHIO.—Bids will be received at the office of the clerk of Board of Education, East Sixth Street, Cleveland, until June 16 for furnishing material and labor for completing the Kennard School, at East Forty-third and East Forty-sixth Streets, as follows: (1) Masonry; (2) cut stone; (3) carpentry; (4) reinforced concrete and fireproofing; (5) iron and steel; (6) metal studding and lathing; (7) plastering; (8) granolithic floors and base; (9) sheet-metal work; (10) blackboards; (12) painting and finishing; (13) glass and glazing; (14) cement floors; (15) plumbing, gas-fitting and sewers; (16) heating and ventilating; (17) electric wiring. Bids will be received separately and in combinations. Plans and specifications are on file in the office of the architect of the board, East Sixth Street. Specifications may be obtained upon application and all proposals must be made on blanks furnished by the director of schools. Frank G. Hegen is director of schools.

COLUMBUS, OHIO.—The McKeever El. Co. has been awarded the contract for installing an electric-light plant in the Neill House, which is being remodeled, at a cost of about $40,000.

COLUMBUS, OHIO.—Bids will be received by S. A. Kinnear, director of public service, Columbus, until June 10 for the installation complete of cluster lamps, on Goodale Street, from High to Park Street (estimated number nine standards); on Broad Street, between Third Street and Grant Avenue (40 standards); on Spruce Street, between High Street and Park Street (11 standards); on Gay Street, between Fourth and Fifth Street (9 standards); on Long Street, between Fourth Street and Washington Avenue (56 standards), in accordance with plans and specifications on file in the office of the director. Separate bids must be submitted for each division of the work. Blank proposal forms may be obtained from the superintendent of the municipal lighting department.

GREENVILLE, OHIO.—The capital stock of the Greenville El. Lt. & Pwr. Co. has been increased from $75,000 to $115,000.

NORWALK, OHIO.—The City Council has authorized Director of Public Service Carpenter to advertise for bids and to enter into a contract for securing plans and specifications for the installation of a municipal electric-light plant for the city. It is proposed to secure estimates for cost of the distributing system and generating plant separately, and for the installation of an ornamental lighting system (cluster lamps) in the business district.

SANDUSKY, OHIO.—The City Council has decided to call a special election on July 1 to vote on the proposition to issue $200,000 in bonds for the construction of a municipal electric-light plant.

HICKMAN, KY.—The Independent Coal Co., of Hickman, expects to purchase an electrically driven crane to be used in handling coal from river barges.

LA GRANGE, KY.—The property of the La Grange Lt. & Pwr. Co. has been purchased by Schaff & Co., of Louisville, for about $10,000.

ROCKPORT, KY.—The City Council has granted the Rockport Coal Co. a franchise to install and operate an electric-light plant and water-works system to supply electricity and water for municipal use. Present plans provide for the installation of ornamental lamps on Main Street. H. L. Tucker is president and manager.

CENTERVILLE, IND.—The Richmond El. Co. of Richmond has been awarded the contract for the installation of the municipal electric-light plant. An appropriation of $6,000 was made to build the plant. The business men of the city are contemplating the installation of an ornamental lighting system on the principal streets.

ALBANY, ILL.—The Rock River Lt. & Pwr. Co., of Sterling, has applied to the Village Board for a franchise to furnish electricity for lamps and motors here.

BUSHNELL, ILL.—The City Council has refused to accept the terms offered by the Central Illinois Pub. Ser. Co., of Mattoon. Steps have been taken by local business men to organize a company with a capital stock of $50,000 to install and operate an electric plant here. Funds have been raised to engage an engineer to make investigations and submit an estimate to the committee as to the cost of the proposed plant.

CAMERON, ILL.—The Rock Island Southern R. R. Co., of Monmouth, is contemplating furnishing electricity for lamps and motors in Cameron and also lighting the streets of the village.

CHESTER, ILL.—The Chester Lt. & Ice Co. is installing two 150-hp boilers in its plant.

CHICAGO, ILL.—The Council finance committee has voted to authorize a contract with the Sanitary District of Chicago for the installation of 15,000 additional flaming-arc lamps or their equivalent. The cost is estimated at about $4,000,000.

DIVERNON, ILL.—The Central Illinois Pub. Ser. Co., of Mattoon, contemplates the purchase of the local municipal electric-light plant.

EAST MOLINE, ILL.—The City Council has decided to change the street-lighting system from arcs to tungsten lamps.

ELGIN, ILL.—The installation of an ornamental street-lighting system on South State Street is contemplated. William Plummer, William Scott Bell and R. H. Howard are interested.

ERIE, ILL.—Application has been made to the Village Board by the Rock River Lt. & Pwr. Co., of Sterling, for a franchise to supply electricity for lamps and motors in Erie.

GRIGGSVILLE, ILL.—The Central Illinois Pub. Ser. Co., of Mattoon, contemplates extending its service to Griggsville and will ack the City Council for a 50-year franchise.

HERSMAN, ILL.—The Central Illinois Public Ser. Co., of Mattoon, contemplates extending its transmission lines to Hersman to furnish electrical service here. The company will be granted a franchise.

HOOPESTON, ILL.—The City Council is considering the question of taking over the electric-light plant of the Hoopeston Gas & El. Co. It is understood that improvements will have to be made to the plant.

OREGON, ILL.—The Illinois Northern Utilities Co. has been awarded a contract to furnish electricity to the National Silica Co., near Oregon. A transmission line is being erected from Sterling.

PARIS, ILL.—We are informed that no definite action has been taken in reference to the proposed ornamental street-lighting system. The proposed plans provide for the erection of 120 lamp standards, carrying five-lamp clusters (the upper lamp 60-watt and the lower 40-watt), to be maintained by underground wires. The cost of the system is estimated at $12,000. Archie E. Wood, of Paris, is chairman of the lighting committee.

PEORIA, ILL.—The Central Union Tel. Co. has decided to rebuild the entire Peoria-Canton-Lewiston pole line and to string additional copper wire, at a cost of about $44,000.

QUINCY, ILL.—It is reported that J. Delbar Roche, of New York, N. Y., and others are interested in a project to erect a hydroelectric power plant at Falls Creek Gorge, 13 miles south of Quincy.

RICHMOND, ILL.—The Village Board has granted the Public Service Co. of Northern Illinois, of Chicago, a franchise to erect and operate an electric-light system in Richmond.

SPRINGFIELD, ILL.—The secretary of the Springfield Pleasure Driveway and Park District has been instructed to advertise for bids for lighting the parks and boulevards. The contract with the Springfield Gas & El. Co. expires July 25.

SPRINGFIELD, ILL.—Application has been made to the State Legislature by Secretary of State Harry Woods for an appropriation of $25,000 for two passenger electric elevators, one freight elevator and an engine and generator to increase the output of the state power plant by 300 hp.

SPRINGFIELD, ILL.—The Southern Illinois Trac. Co., with principal offices in St. Louis, Mo., has filed an amendment to its charter with the Secretary of State, increasing its capital stock from $1,500,000 to $7,500,000 and making changes in the proposed route as follows: From East St. Louis through Bellville, New Athens and Marissa to Pinckneyville and Duquoin, passing through St. Clair, Randolph and Perry Counties. W. E. Trautman, Frederick Essen and A. W. Morriss are among the directors.

SUPERIOR, WIS.—The Superior Wtr., Lt. & Pwr. Co. contemplates improvements to its electric plant and service. New machinery will be installed.

BREWSTER, MINN.—There is a movement on foot to establish a municipal electric-light plant in Brewster. The cost of the plant is estimated at $3,500.

BUHL, MINN.—The contract for new apparatus for the municipal electric-light and water-works plant was awarded to the Northern Electrical Co., of Duluth, instead of the Northern El. Co., of Minneapolis, as reported in the issue of May 17.

DEERWOOD, MINN.—The Cuyuna Range Pwr. Co., of Deerwood, has closed down its local steam plant and is now securing electricity from its hydroelectric power plant on the Crow Wing River, 10 miles from Brainerd. The plant is equipped with two 600-kva generating units and a third unit will be installed next fall. The company has closed a contract with the city of Brainerd to furnish energy at the switchboard for a period of nine and one-half years. It also has franchises in Deerwood, Crosby, Cuyuna and Ironton and furnishes one mining company about 300 kw continuous service. M. D. Stoner is manager.

HUTCHINSON, MINN.—The properties of the Hutchinson Ltg. & Mfg. Co., of Hutchinson, and the Glencoe El. Lt. Co., of Glencoe, have been purchased by Coler Campbell, of Huron, S. D. The combined properties will for the present be operated under the management of Thomas Pitts, formerly manager of the Hutchinson plant.

STARBUCK, MINN.—The town of Starbuck expects to purchase within the next two months for the municipal electric-light plant and system one 55-hp boiler (100-lb. pressure), one 30-kw, 225-volt direct-current generator, one 50-hp Corliss engine, smokestack, etc., and within the next four or eight weeks 3000 ft. No. 10 weatherproof wire and 6000 ft. No. 6 weatherproof wire. A. H. Dreyer is superintendent of the electric-light department.

ALTON, IA.—Messrs. Mason & Mason are installing an electric-light plant in Alton to furnish electrical service here. Equipment for the plant has been purchased.

AUDUBON, IA.—The Audubon County El. Co., which recently took over the local electric-light plant, expects to erect within the next two months a 10,000-volt, single-phase transmission line from Audubon to Hamlin and Exira and expects to purchase 50-kw and 75-kw, 10,000-2300-volt transformers and 2300-220-110-volt transformers (sizes from 2½-kw to 5-kw). Within the next six months the company expects to purchase electrical appliances, including flatirons, etc. The company has already purchased one 250-hp compound Corliss engine, one 150-kw, three-phase, 60-cycle generator, exciter and jet condenser with switchboard and instruments for same. R. E. Wieland is owner and manager.

CEDAR RAPIDS, IA.—The trustees of the city water-works are contemplating equipping the main pumping station for electrical operation and the erection of three electrically driven booster pumping stations.

CENTRAL CITY, IA.—The Wapsipinicon Pwr. Co., of Central City, expects to purchase within the next six months material for 16 miles of transmission lines. The company deals in electrical appliances and supplies. William E. Fisher is secretary and treasurer.

DECORAH, IA.—The Interstate Pwr. Co., of Decorah, expects to erect within the next twelve months a central power station (steam turbine), also to purchase equipment for same, and to erect from 90 to 100 miles of high-tension transmission line, substations, etc., also to purchase equipment for same, to serve the towns of the South Dakota division, including Wagner, Armour, Platte, Lake Andes and Scotland. The company recently extended its transmission lines to Cresco, a distance of 22 miles, to furnish energy to its plant there. Preparations are under way to raise the voltage of entire system to 13,200 volts, now operating at 6600 volts (100 miles of high-tension transmission lines in service). The city of Decorah is erecting 78 ornamental street lamp-posts and the city of Cresco is also erecting ornamental lamp standards. J. G. Hardenburgh has contracts for installing systems in both cities. G. W. Welch is electrical engineer.

DUBUQUE, IA.—The Union El. Co., of Dubuque, has just completed the installation of a 2500-kw General Electric turbine and accessories. E. M. Walker is general manager.

LAWLER, IA.—An election will soon be held to vote on the proposition to install an electric-lighting system in Lawler.

LENOX, IA.—The Lenox El. Co. is installing an electric-light plant here. The equipment will consist of one General Electric 90-kw, two-phase generator, one 80-hp Murray-Corliss engine and one 100-hp Murray boiler, contracts for which have been placed. F. A. Thompson is manager.

PERRY, IA.—The electric power plant owned by Waterson & Cowherd was destroyed by fire on May 16.

SIGOURNEY, IA.—Extensions will be made to the plant of the New Sigourney El. Lt., Ht. & Pwr. Co., including the installation of new boilers, generators and other equipment. The company is now rebuilding most of its transmission lines in the town.

SIOUX CITY, IA.—Extensive improvements and additions will be made to the Sioux City Service Co's plant at Second and Water Streets, which will involve an expenditure of about $100,000 and include two large new boilers to be added to the present battery of eight, a new air compressor and two new generators, also addition to the power house.

SPENCER, IA.—Improvements are contemplated to the municipal electric-light plant, including the installation of a 90-kw or 120-kw alternating-current generator and Corliss engine. Contracts will probably be awarded some time in June or July. Etta M. Smith is city clerk.

WHITING, IA.—The contract for construction of an electric light and power plant has been awarded to the Alamo Engine & Supply Co., of Omaha, Neb., for $10,490.

ASH GROVE, MO.—The Ash Grove Milling & El. Co., recently incorporated, is installing additional equipment in its flour mill and will furnish electricity for lamps and motors in this city. M. L. Weygandt is president.

CAMPBELL, MO.—The Campbell Mill & Lt. Co. expects to erect 11 miles of transmission lines to take in three small towns within the next six months. T. R. Hutchinson is president.

DEXTER, MO.—Benjamin F. Eicholtz, owner of the local electric-light plant, expects to install next September a 125-kw, three-phase, 2300-volt generating unit (belted) and to purchase a complete switchboard equipment. Mr. Eicholtz would like to receive catalogs and literature on electrical appliances and supplies, including heating and cooking apparatus, vacuum cleaners, washing machines, etc.

GAINESVILLE, MO.—The Missouri Gas. & El. Co., of Gainesville, expects to erect within the next three months about 3 miles of transmission lines and to purchase about one carload of white cedar poles, 10,000 ft. No. 8 wire, four transformers and about 50 meters. The company now does house wiring and deals in electrical supplies. L. J. Beauregard is chief clerk.

ST. CHARLES, MO.—The city of St. Charles has contracted with the American Lt. & Pwr. Co. to furnish electricity in this city, thereby discarding the municipal plant. The company was also given a contract to light the streets of the city for a period of ten years. Under the new contract arc lamps will be used in the business district and tungsten lamps in the residence section. Electricity for operating the system will be secured from the power plant at the Keokuk dam. The contract goes into effect July 1. Charles H. Kausteiner is city clerk.

SENECA, MO.—The property of the Seneca Mill & Elevator Co., of Seneca, has been purchased by H. H. Mace, of Mount Grove. The new owner is planning to put the plant in operation and also to install an electric-lighting system, furnishing a 24-hour service.

SOUTHWEST CITY, MO.—The local electric-light plant, owned by S. A. Robinson, was destroyed by fire on March 7 and as yet has not been rebuilt.

WASHINGTON, MO.—The Mississippi River Pwr. Distributing Co., which recently purchased the property of the Tibbe El. Co., of Washington, contemplates the extension of a transmission line from St. Louis to Washington, Union and Pacific, Mo. Various changes will be made to the local system, including pole-line transformers, lightning arresters, wire, etc. H. D. Hibbeler is local manager.

BLUNT, S. D.—The power plant of the Blunt Lt. & Pwr. Co. was destroyed by fire on May 12, causing a loss of about $7,000.

ATKINSON, NEB.—J. Skredla & Sons, owners of the local electric-light plant, expect to purchase within the next two weeks one 60-kw generator and one 3-kw exciter, with switchboard, and one 80-hp oil engine. J. Skredla is manager.

BROKEN BOW, NEB.—The Custer El. Co. is planning to establish a day service (one day each week) for domestic purposes and will pur-

chase irons, vacuum cleaners, washing machines, etc. E. P. Steen is manager.

CRETE, NEB.—The city of Crete expects to purchase within the next six months a forced-draft system for the municipal electric-light plant and an ornamental street-lighting system (probably 20 posts). E. G. Campbell is superintendent.

FAIRBURY, NEB.—The managers of the municipal electric-light plant expect to purchase within the next six weeks material for distributing system, including wire, insulator pins, cross-arms and braces for series street-lighting system. G. D. Myers is superintendent.

SILVER CREEK, NEB.—Bonds to the amount of $16,000 have been voted for the installation of a combined electric-light plant and water-works system here. Bruce & Stadeven, of Omaha, engineers, have charge of the engineering work. A pressure-tank system will be installed and 7000 ft. of 4-in. and 1000 ft. of 6-in. water mains will be laid. The village already has an electric plant owned by private parties which it proposes to purchase if price is satisfactory, otherwise it will build a new plant. Dyo F. Davis is village clerk.

STRATTON, NEB.—The village of Stratton expects to purchase some meters for the municipal electric-light plant within the next 12 months. Elmer Martin is engineer.

Southern States

SILER CITY, N. C.—The Siler City Lt. & Tel. Co. is building a 200-ft. concrete dam across Rocky River, about 4 miles from the town. The company expects to have its plant ready for operation about Nov. 1.

LOCKHART, S. C.—The Lockhart Pwr. Co. has awarded the contract for construction of a solid masonry dam (1500 ft. long and 14 ft. high) across Broad River, to cost $150,000, to Willard Boggs & Co., of Spartanburg.

LAWRENCEVILLE, GA.—The City Council has closed a contract with the North Georgia Pwr. Co., to furnish electricity to the city for next year. It is estimated that the city will save about $1,400, besides having a day service.

JACKSONVILLE, FLA.—Bids will be received by the board of trustees for the water-works and improvement bonds of the city of Jacksonville, Fla., until June 4 for furnishing switchboard, instruments and wiring in accordance with specifications, which are on file in the office of the board and at the office of the Scofield Engineering Co., consulting engineer, Philadelphia, Pa. W. M. Bostwick, Jr., is chairman of board.

JACKSONVILLE, FLA.—Bids will be received by the board of trustees for the water-works and improvement bonds of the city of Jacksonville, Fla., until June 4, for furnishing and erecting complete, including brick work, and ready for pipe connections on foundations furnished by the city at the new power station, of two 509-hp horizontal water-tube boilers (for a 200-lb. working pressure), complete with superheaters, Peabody oil burners, flue breeching and lining, complete. Plans and specifications are on file in the office of the board and at the office of the Scofield Engineering Co., of Philadelphia, Pa., consulting engineers. W. M. Bostwick, Jr., is chairman of board.

MONTEREY, TENN.—The Monterey Fruit & Vegetable Association, which was recently granted a franchise, is planning to install an electric-light plant to cost about $10,000. G. N. Welch, T. E. Goff and J. T. Price are interested in the company.

SHELBYVILLE, TENN.—The Duck River Lt. & Pwr. Co. is making arrangements to increase the output of its hydroelectric power plant at the old Mullins Mill site, 4 miles from Shelbyville, and will install additional waterwheels and generators.

SPRINGFIELD, TENN.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until July 2, for construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior lighting fixtures and approaches, of the United States post office building at Springfield, Tenn. Drawings and specifications may be obtained at the above office or from the custodian of site. O. Wenderoth is supervising architect.

BAY MINETTE, ALA.—The Commissioners of Baldwin County are considering the question of installing an electric-light plant to furnish electricity to light the new jail, court house and the grounds around the buildings.

BIRMINGHAM, ALA.—Plans are being prepared by the Kelley Co. to construct a power plant, at a cost of $250,000, to furnish electricty to operate a proposed railway, 17 miles long, and also for lamps and motors in Birmingham. W. E. Kelley is manager.

JACKSON, ALA.—The Bigbee Ice & Devel. Co. expects to purchase within the next three months forty 5-amp and 10-amp, 220-volt meters and about 2000 ft. No. 14 wire. John C. Brown is secretary and treasurer.

ROANOKE, ALA.—The city of Roanoke contemplates the erection of a power house and 5 miles of new transmission lines and also the purchase of two 150-hp boilers and one 300-hp engine, one 12-kw exciter, one 750-gal. pump, one boiler-feed pump (both driven by electric motors), one switchboard, 12 transformers, 300 poles, about 20 lightning arresters, 1000 insulators, one tub transformer for 100 series 6.6-amp arc lamps. W. S. Greene is superintendent.

JACKSON, MISS.—The Capital Lt. & Pwr. Co. has recently rebuilt its plant (using old apparatus and switchboard) and will erect about 5 miles of overhead wire. The company expects to start a campaign to advocate the use of heating devices within the next three months. Collins Johnson is secretary and manager.

WIGGINS, MISS.—The Wiggins El. Lt. Co. expects to purchase within the next three or four months one 150-kw, 60-cycle, 2200-volt generator (belted), with exciter and switchboard. A. W. Reed is treasurer and manager.

ATKINS, ARK.—A company has been organized for the purpose of building an electric-light plant in Atkins. The capital stock is placed at $15,000. It is proposed to have the plant in operation within 90 days. The officers are: W. H. Jones, Sr., president; J. M. Bronson, vice-president; W. H. Jones, Jr., secretary; G. F. Ernest, treasurer, and L. L. Evans, general manager.

BATESVILLE, ARK.—The commissioners of the water and light plant expect to erect within the next three months a new stone power house (100 ft. by 50 ft.); also to purchase one 150-kva or 180-kva, three-phase, 60-cycle generator (belt-driven) and switchboard panel for same within the next six months. The city is contemplating the construction of a 1000-kva hydroelectric plant at one of the federal dams, to cost about $80,000, and is waiting for action by the federal government. W. H. Walkup is superintendent.

BENTONVILLE, ARK.—The Arkansas & North Western R. R. Co. has taken an option on the municipal electric-light plant in Bentonville. Extensions to the plant are pending result of the option, which expires in June, 1913. Carroll Holt is superintendent.

JONESBORO, ARK.—The city of Jonesboro expects to purchase 35 tons of 4-in. and 6-in. cast-iron water pipe and pig lead for laying same within the next 30 days. J. F. Christy is manager of the municipal electric-light and water plant.

HINTON, OKLA.—The contract for constructing an electric-light plant and water-works system has been awarded to Don A. Tolbert, Ada, Okla. The Benham Engineering Co., of Oklahoma City, has charge of the engineering work.

AUSTIN, TEX.—It is announced that the survey for the proposed electric interurban railway of the Guadalupe Trac. Co. between Austin and San Antonio via Seguin and Lockhart, has been completed from Austin to Lockport (a distance of 30 miles), and that work will be started early in June. The company proposes to build a large hydroelectric power plant on the Guadalupe River near Seguin to furnish electricity to operate the railway. A. B. Axtell is chief engineer.

AUSTIN, TEX.—The Colorado River Pwr. Co., which is headed by C. H. Alexander, of Dallas, recently filed on the water rights of a section of the Colorado River above Austin preliminary to constructing a large dam and erecting a hydroelectric plant at a point about 40 miles north of here. Mr. Dallas and associates also have under consideration the construction of a dam across the Colorado River near Ballinger, to cost approximately $1,000,000, for the purpose of creating a storage reservoir for irrigating about 75,000 acres of land in that section.

DENISON, TEX.—The City Council has called an election to be held on June 21 to vote on the franchise offered by the Texas Pwr. & Lt. Co., of Dallas. If granted a franchise, the company proposes to erect a large hydroelectric power plant on the Red River, north of the city, at a cost of $1,000,000.

HILLSBORO, TEX.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 27 for the construction, including plumbing, heating apparatus, gas piping, electric conduits and wiring and interior lighting fixtures, of the United States post office at Hillsboro, Tex. Plans and specifications may be obtained at the above office or from the custodian of site at Hillsboro, Tex. O. Wenderoth is supervising architect.

MOUNT PLEASANT, TEX.—The Mount Pleasant El. Lt. & Pwr. Co. contemplates the installation of additional equipment, to cost approximately $175,000.

Pacific States

EATONVILLE, WASH.—Investigations are being made by Evans & Dickson, of Tacoma, engineers, engaged by the Town Council in connection with the installation of a municipal electric-light plant. It is very probable that three different propositions for securing power will be submitted to the voters as follows: Hydroelectric plant on Little Mashell River, hydroelectric plant on Lynch Creek, and the erection of a transmission line to the Tacoma power plant at La Grande. Charles C. Biggs is town clerk.

ENUMCLAW, WASH.—The City Council has granted the Enumclaw Wtr. & Lt. Co. a franchise to construct and operate an electric-light and power plant in Enumclaw for a period of 50 years.

EPHRATA, WASH.—Eastern capitalists, headed by William Scheffel, of Salt Lake City, Utah, who recently filed application for water rights for power purposes of Rock Island Rapids, will erect power stations at several points. It is proposed to build a 25,000-hp plant at Rock Island Rapids.

OLYMPIA, WASH.—The City Council has granted Millard Lemon and Wilbur B. Forshay a franchise to erect and operate an electric-light

plant in Olympia. Work will soon begin on construction of the proposed plant.

SEATTLE, WASH.—A. H. Dimock, city engineer, has recommended to the City Council the acquisition of the Lake Cushman power site offered to the city of Seattle by Joseph E. Wickstrom for $640,000, the purchase of which was authorized by the voters at the city election held March, 1912. It is estimated that 62,200 hp can be developed at a cost of $5,063,00, exclusive of the cost of the power site. Two routes are proposed for the transmission line, one, about 78 miles in length, running south to Union City, Allen and Burley and spanning the narrows near Tacoma with a 5800-ft. span. The other route proposed would be about 100 miles long and would avoid this span by going by the way of Olympia, thence to Seattle.

TACOMA, WASH.—The citizens recently voted to authorize the construction of a municipal car line from the business district to tide flats. It is expected that the railway will be built, as the proposition is favored by Mayor Seymour and Council.

TACOMA, WASH.—G. Sands and J. D. Wheeler, both of Seattle, promoters of the Seattle-Tacoma-Olympia R. R. Co., have been granted a permit to build a temporary monorail system on the tide flats. The company proposes to build a monorail system from Olympia to Seattle, via Tacoma.

ASTORIA, ORE.—The ways and means committee of the City Council has instructed Engineer Bergsvik to investigate the feasibility of establishing a municipal lighting plant here. The construction of a dam 53 ft. in length and 60 ft. high, to cost $300,000, capable of developing 3000 hp, is contemplated.

COTTAGE GROVE, ORE.—The Oregon El. Ry. Co., of Portland, contemplates the construction of a hydroelectric power plant on the upper McKenzie River, above Belknap. G. S. Edmuston has been instructed to make investigations and prepare an estimate of the cost of same.

HAMMOND, ORE.—W. H. Galvani, engineer, representing the Pacific Pwr. & Lt. Co., of Portland, has applied to the City Council for a franchise to furnish electricity for lamps and motors here. The company has also petitioned the County court for permission to erect transmission lines on the country road from Astoria to Warrenton and as far west as Fort Stevens.

HOOD RIVER, ORE.—The Pacific Pwr. & Lt. Co., of Portland, has discontinued construction work on its $500,000 hydro-electric plant in Hood River, same to be resumed next fall. The company, it is stated, is preparing plans for the construction of a 3500-hp hydroelectric plant on the Natchez River near North Yakima, Wash.

BEAUMONT, CAL.—The Southern California Edison Co., Los Angeles, has applied to the State Railroad Commission for permission to construct and maintain a distributing system in Beaumont.

DURHAM, CAL.—The Durham Lt. & Pwr. Co. expects to purchase within the next six months 10 transformers, 300 poles, 5000 ft. copper wire, 40 meters and about 100 incandescent street lamps; it also expects to expend within the next 12 months about $1,000 for electrical appliances, including heating and cooking apparatus, vacuum cleaners, washing machines, wiring supplies, etc. J. A. Foster is manager.

GRASS VALLEY, CAL.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 30, for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, interior-lighting fixtures and approaches, of the United States post office at Grass Valley. Drawing and specications may be obtained at the above office or from the custodian of site at Grass Valley. O. Wenderoth is supervising architect.

HUNTINGTON PARK, CAL.—Bids will be received by the Board of Trustees of the Huntington Park City School District until June 7 for the construction of a six-room and auditorium school building, to be located on Miles Avenue, near Hoe Street, as follows: (1) General contract, including heating and ventilating, but not including plumbing, wiring, electric fixtures, painting, tinting, sidewalks and blackboards; (2) plumbing and cesspools; (3) painting and tinting; (4) electric wiring; (5) electric fixtures; (6) blackboards; (7) sidewalks, in accordance with plans and specifications on file with and which may be obtained from Train & Williams, architects, 225 Exchange Building, Los Angeles. Orville W. Jones is clerk.

LAKEPORT, CAL.—The State Railroad Commission has granted the Mount Konocti Lt. & Pwr. Co. permission to issue $20,000 in capital stock and a promissory note for $5,000, the proceeds to be used for extensions to its transmission lines.

LOS ANGELES, CAL.—H. E. Huntington is having plans prepared for a 12-story building to be erected at Twelfth and Main Streets, Los Angeles, in the basement of which the Pacific Lt. & Pwr. Corpn. will install a substation from which it will distribute alternating and direct current to the business district of the city. It is expected to have the plant in operation in September.

NEEDLES, CAL.—The State Railroad Commission has granted the Arizona-California-Nevada Tel. Co. permission to sell its plant to the Needles Gas & El. Co.

PASADENA, CAL.—The city of Pasadena requests bids for furnishing and installing 362 ornamental cost-iron lamp-posts with conduits, transformers, etc., on Los Robles Avenue, between the northern and southern boundaries of the city. Herman Dyer is city clerk.

PORTERVILLE, CAL.—Rights-of-way are being secured for the high-tension transmission lines of the San Joaquin Valley Pwr. Co., of Fresno, from Porterville to a substation at Famosa, a distance of 60 miles. A new hydroelectric plant, to cost over $1,000,000, is being erected in the hills east of here, from which the company will supply electricity to the oil fields of the west side and also for the various industrial plants, etc., in Kern County.

REDLANDS, CAL.—The Southern Sierras Pwr. Co., of San Bernardino, has applied to the State Railroad Commission for permission to distribute electricity in the city of Redlands.

SAN FRANCISCO, CAL.—The State Railroad Commission has granted the Southern Sierras Pwr. Co. permission to operate in Kern County.

SAN FRANCISCO, CAL.—The Pacific Gas & El. Co., of San Francisco, has been authorized by the State Railroad Commission to issue $5,000,000 in debentures, of which the proceeds of $3,750,000 will be used for the reimbursement for expenditure from income, the balance to be used for general improvements to its system.

WATTS, CAL.—At an election to be held June 17 the proposition to issue $15,000 in bonds for the installation of a fire-alarm system will be submitted to a vote.

WILLIAMS, ARIZ.—The Williams Wtr. & El. Co. expects to purchase within the next 30 days two 25-cycle, 4400-volt generators and one 60-cycle, 2200-volt generator. An engine has already been installed.

DILLON, MONT.—The Union El. Co., of Dillon, expects to purchase within the next three months a 360-hp waterwheel operating under a 220-ft. head to replace the old waterwheel.

LIBBY, MONT.—We have been informed that the contracts have been awarded and the improvements and extensions nearly completed by the Libby Wtr., El. Lt. & Pwr. Co. It was reported in the issue of May 17 that the work was contemplated.

ROUNDUP, MONT.—The Roundup Coal Mining Co. expects to install in its No. 4 mine power house two 150-kw Kerr turbines and equip the entire mine for electrical operation, including haulage, pumping, etc. within the next two months. The company will also install two 300-hp Murray boilers at No. 3 mine and two 300-hp boilers at No. 4 mine. E. L. Rousseau is assistant general manager.

TYRONE, N. M.—Phelp-Dodge & Co., owners of the Chemung copper mine in Tyrone, contemplate the construction of a large electric power plant to furnish power to operate the pumps of the mine and for operating the cars through the tunnel that connects the Chemung Mine with the Leopold Mine.

Canada

VANCOUVER, B. C.—The British Columbia Tel. Co., Ltd., will lay a submarine cable across the Saanich Inlet between a point on the east shore of Saanich Inlet and Vancouver Island. Bids for material and placing same will soon be called.

VANCOUVER, B. C.—Plans are being prepared by the British Columbia Tel. Co. for extensions to the Nanaimo branch, at a cost of $20,000, and for laying a submarine cable between Vancouver and Nanaimo, to cost about $120,000. Improvements will also be made to the telephone service in Nanaimo.

WINNIPEG, MAN.—Bids will be received by the chairman of Board of Control until June 5 for furnishing material and constructing an extension to the power terminal station. Instructions to bidders, plans, specifications and form of tender may be obtained at the office of the City Light and Power Department, 54 King Street. M. Peterson is secretary.

BERLIN, ONT.—The Dominion Tire Co., which is completing a new plant in Berlin, at a cost of $300,000, has decided to erect a power plant in addition, to cost $50,000, on which work will begin immediately.

CHATHAM, ONT.—The Hydro-Electric Power Commission of Ontario has submitted estimates to the city of Chatham for furnishing 1200 hp at 13,200 volts. The cost of distributing system for lamps and motors, including substation and transmission line from the transforming station of the commission, is estimated at $67,308; multiple street-lighting system, including a certain amount of underground work, with lamp standards, $14,264, and engineering and contingencies, $8,157, making a total of $89,729.

OTTAWA, ONT.—The directors of the Ottawa Lt., Ht. & Pwr. Co. have authorized an issue of $800,000 in additional capital stock, the proceeds to be used to build and equip a gas plant in the east end of the city and for extensive additions and improvements being made to the electric-light and power plants in this city.

TORONTO, ONT., CAN.—Tenders will be received by Adam Beck, chairman Hydro-Electric Power Commission, Continental Life Building, Toronto, Ont., until June 16 for the construction of a concrete dam and reinforced-concrete power house at Wasdell's Falls, on the Severn River. Plans and specifications may be seen at the offices of the commission and copies of same obtained, for which a deposit of $5 will be required, to be refunded upon return of plans. W. W. Pope is secretary.

MONTREAL, QUE.—The town of La Vallée has granted the Montreal Lt., Ht. & Pwr. Co. a franchise to light the town.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing officer, Isthmian Commission, Washington, D. C., until June 10 for furnishing electric hoists, wire rope, nails, tacks, nuts, cable clips, hammers, switch ties, etc. Blank forms and general information pertaining to this circular (No. 777) may be obtained from the above office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y., 614 Whitney-Central Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Major F. C. Boggs is general purchasing officer.

New Industrial Companies

CHARLES CORY & SON, INC., of New York, N. Y., has been incorporated by Charles Cory, Ella M. Cory and John M. Cory, of 60 West Seventy-sixth Street, New York, N. Y. The company is capitalized at $100,000 and proposes to manufacture and deal in electrical, mechanical and metal equipment for ships.

THE ELECTRIC SIGNAL COMPANY, of Worcester, Mass., has been incorporated with a capital stock of $50,000 by J. H. Wheelock and W. J. Sheehan, of Worcester. The company proposes to manufacture electrical devices.

THE I. S. VAN LOAN RAILWAY EQUIPMENT COMPANY, of New York, N. Y., has been incorporated with a capital stock of $125,000 to deal in engines, machinery, hardware supplies, etc. The incorporators are: A. C. Case, of New York, N. Y.; D. Pierson, Jr., of East Orange, N. J., and E. W. Samuel, of Mount Carmel, Pa.

THE M. R. T. ELECTRIC LIGHT & STARTER COMPANY, of Des Moines, Ia., has been organized for the purpose of manufacturing electric self-starters for automobiles. The proposed plant will be located in Des Moines. The officers are: A. H. Millard, president; J. E. Robinson, general manager, and George F. Trotter, engineer.

THE SINGER ELECTRIC & MACHINE COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $1,000 to manufacture machinery and tools by Frank E. Scott, Frederick O. Singer and I. S. Wells.

THE C. D. WOOD ELECTRIC COMPANY, of New York, N. Y., has been incorporated by C. D. Wood, B. Kenneth Wheeler and Louis A. Seitz, of 63 Wall Street, New York, N. Y. The company is capitalized at $20,000 and proposes to deal in electrical supplies.

New Incorporations

WILMINGTON, DEL.—The Best El. Co. has been incorporated with a capital stock of $50,000 by Harry W. Davis, of Wilmington, Del.

CHICAGO, ILL.—The Corn Belt Utilities Co. has been chartered with a capital stock of $2,500 to operate electric plants. The incorporators are: Llewellyn M. Willey, Frederick E. Koehle and Clarence A. Toolen.

MOUNT PULASKI, ILL.—The Mount Pulaski El. Lt., Ht. & Pwr. Co. has been incorporated with a capital stock of $40,000 to operate a light, heat and power plant. The incorporators are: Ira Vail, D. W. West and Clarence E. West.

HOLSTEIN, IA.—The Holstein Ser. Co. has been organized for the purpose of building and operating an electric light plant in Holstein. The officers are: Henry Dessel, president; W. F. Hutton, secretary, and C. J. Wohlenberg, treasurer.

LOUISVILLE, KY.—The Foundation Company has been organized with a capital stock of $2,000 by D. Long Miller, George G. Fetter, J. R. Todd, Leo H. Holzbag and R. W. Bingham. The company proposes to supply light, heat and power in this county.

CINCINNATI, OHIO.—The Cincinnati Pwr. Co. has been incorporated with a capital stock of $10,000 by Henry Bentley, W. B. Mente, Clifford M. Stenger, B. S. Hughes and others.

PHILADELPHIA, PA.—The Falls Lt. Co. has been incorporated with a capital stock of $5,000 by Walter T. Bilyeau, 6352 Sherman Street, Germantown.

ABILENE, TEX.—The Fulwiler El. Co. has been incorporated with a capital stock of $25,000 by W. J. Fulwiler, G. T. Scales and R. H. Clark.

CENTER, TEX.—The Pittman Ice & Lt. Co. has been organized with a capital stock of $40,000. The officers are: T. T. Smith, president; J. S. Kennedy, vice-president, and W. I. Davis, secretary.

ROCKWALL, TEX.—The Rockwall Lt. & Pwr. Co. has been granted a charter with a capital stock of $25,000 to operate an electric plant. The incorporators are: Hiram Grossman, M. Grossman, Wallace Woodlief, W. D. Austin and W. Fred Leonard.

RICHMOND, VA.—The Southern Gas & El. Co. has been granted a charter with a capital stock of $1,000 to $2,000,000 for the purpose of purchasing and selling gas and electric properties, merging the same, operating or leasing or acting as a holding company for such companies. Joseph T. England, of Baltimore, Md., is president; Alexander H. Sands, of Richmond, secretary.

Trade Publications

PYROMETERS.—The Hoskins Manufacturing Company, 453 Lawton Avenue, Detroit, Mich., has issued Bulletin No. 3, which deals with its thermo-electric pyrometers. It contains a comprehensive discussion of this device, and will be of interest both to the prospective and the present user of pyrometers.

COPPER-CLAD STEEL WIRE.—An attractive catalog has recently been issued by the Duplex Metals Company, Chester, Pa., devoted to its copper-clad steel-wire product. The process of manufacture is told in brief in this booklet and data are given on the physical characteristics of the wire, on tests and on modern specifications. Finally, tables of prices and freight charges are included to assist the buyer.

CONSTRUCTION APPLIANCES.—A bulletin of the Brady Electric & Manufacturing Company, New Britain, Conn., which has been issued as an addition to Catalog No. 12, shows a line of electric appliances for outside construction made by this company. Within its twenty-four pages are given illustrations of such appliances as goosenecks, mast-arms, pole-arms, street incandescent fixtures, automatic cutouts and other devices of a similar kind.

WATER-POWER.—The Stone & Webster Engineering Corporation, 147 Milk Street, Boston, Mass., has issued a booklet containing brief data regarding various water-power plants constructed by this company. Twelve plants are described, six low-head plants, four medium-head plants and two high-head plants. The publication is attractively printed and bound in dark board covers. The forty-three plates give one a good general idea of the magnitude of some of these installations.

VALVE CHART.—The Harrison Safety Boiler Works, Philadelphia, Pa., have issued a chart or diagram showing the internal construction of the Cochrane multiport safety exhaust outlet valve. This device can be used either as a back-pressure valve for exhaust-steam-heating or drying systems or as an atmospheric relief valve for use in connection with vacuum cleaners. The distinguishing feature is the number of small disks instead of one large disk, each held to its seat by an independent spring.

VENTILATING FANS.—The Mechanical Appliance Company, Milwaukee, has published Booklet No. 151 describing the Watson motor-driven ventilating fans in sizes from 18 in. to 42 in. for direct-current and alternating-current, single and polyphase circuits. Methods of installation are illustrated, and a chart is included for determining fan capacity required for rooms of various sizes and used for various purposes, such as moving-picture theaters, garages, billiard parlors, restaurants, schools, etc.

EXPERT ASSISTANCE BEFORE COMMISSIONS.—Bulletin No. 4 of the department of examinations and reports of H. M. Byllesby & Company, Insurance Exchange Building, Chicago, gives some valuable information about state public utility commissions. Lists are given of states having commissions regulating gas and electric utilities, also those having railroad commissions and those in which public utility commission bills are pending. H. M. Byllesby & Company offer the services of their experts in examinations and reports to counsel for public-service companies in commission cases.

SUPPLY DEALER'S METHOD OF ADVERTISING.—The Columbian Electrical Company, 820 Frederick Avenue, St. Joseph, Mo., is sending out to prospective purchasers of heating and cooking devices, electroliers, vacuum cleaners—in fact, of anything electrical—a cardboard folder, 4 in. by 5.5 in. On the left-hand inside page, surrounding a calendar for 1913, is a strip of assorted darning needles and a package of sewing needles. This should make instant appeal to the feminine recipient and cause her to read the opposite page, which makes a brief reference to electric-cooking devices and contains an invitation to visit the Columbian Company's showrooms.

Business Notes

THE ELECTRIC RAILWAY EQUIPMENT COMPANY'S New York office has been moved from 90 West Street to 30 Church Street. Mr. J. J. Kipp, general Eastern agent, is in charge.

THE HOLTZER-CABOT ELECTRIC COMPANY has opened a New York office in the Architects' Building, Park Avenue and Fortieth Street, where Mr. M. J. McElroy will be in charge.

THE JOHN A. ROEBLING SONS COMPANY, of 117 Liberty Street, New York, has bought the seven-story building at 169-175 Hudson Street, and will eventually move its offices to that location.

THE FORT WAYNE ELECTRIC WORKS of the General Electric Company have removed the Chicago office from 623 Marquette Building to the tenth floor of the Monadnock Building, where the Chicago offices of the General Electric Company are located.

ROCKWELL ELECTRIC COMPANY.—Mr. Edwin R. Rockwell, formerly president of the Guarantee Electric Company, has been instrumental in the formation of the Rockwell Electric Company, with offices at Suite 1139 First National Bank Building, Chicago. The company, which will be the agent for various types of electrical machinery and appliances, also offers its services in all branches of electrical engineering.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MAY 20, 1913.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York.]

1,061,992. TROLLEY-WIRE SPLICE; W. J. Dukro, Lima, Ohio. App. filed May 24, 1912. Tubular end portions with inclined sleeve extensions in which the ends of the trolley wire are clamped by set screws, the extreme ends of the wires being clamped to a base plate.

1,062,004. TELEPHONE SYSTEM; R. C. M. Hastings, Columbus, Ohio. App. filed April 22, 1912. Only two subscribers in telephonic communication at a time, the other subscribers being shunted from the line and a signal being displayed to such shunted subscribers that the line is "busy."

1,062,016. PROCESS OF PRECIPITATING ULMIC COMPOUNDS FROM THE BLACK LIQUORS OF SODA-PULP MILLS; N. A. Langlet, Gothenburg, Sweden. App. filed July 30, 1909. Regenerates caustic soda by adding sodium chloride to the liquor, exposes the liquid at not lower than 65 deg. C. to electrolysis to precipitate dissolved organic substances and separates precipitate from the liquor.

1,062,017. ARMATURE-LEVER PIVOT FOR ALTERNATING-CURRENT MAGNETS; D. Larson, Yonkers, N. Y. App. filed Nov. 14, 1908. Armature lever is mounted on an elastic pivot rod and said lever is recessed to prevent contact with the rod adjacent to the bearing lugs in which the rod is journaled.

1,062,031. ELECTRIC METER; W. H. Pratt, Lynn, Mass. App. filed March 13, 1911. Flux-shifting device between the potential and series poles comprising two S-shaped conducting members superposed in a reversed position.

1,062,046. ELECTRICAL APPARATUS; H. B. Smith, Worcester, Mass. App. filed Jan. 10, 1908. Transformer; plurality of cylindrical barriers of bare conducting material separated by fluid insulation are interposed between the winding and core to constitute a series of equal-capacity condensers.

1,062,052. OVERSPEED DEVICE FOR DYNAMO-ELECTRIC MACHINES; H. G. Scott, New York, N. Y. App. filed April 5, 1907. Magnetic relay dependent directly upon the weakened field of the dynamo interrupts the direct-current circuit.

1,062,058. ELECTROLYTIC CELL; R. Threlfall, Birmingham, England. App. filed Feb. 27, 1912. Eventual main electrodes and intermediate electrodes therebetween are mounted in an inner non-conducting tube open to the electrolyte; electrodes arranged at an angle to provide ducts for gases and liquid products of electrolysis.

1,062,082. TELEPHONE RECEIVER; E. B. Craft and J. N. Reynolds, Hackensack, N. J., and Greenwich, Conn. App. filed Jan. 2, 1912. Magnet system having a permanently magnetized steel bar and a soft-iron pole piece welded thereto.

1,062,083. STORM AND SURGE ALARM FOR TRANSMISSION LINES; E. E. F. Creighton, Schenectady, N. Y. App. filed Sept. 2, 1908. Small wire running parallel with the line has one end grounded through a coherer which controls a local circuit containing an alarm.

1,062,096. CONTROLLER FOR ELECTRIC MOTORS; C. T. Henderson, Milwaukee, Wis. App. filed July 10, 1909. Means responsive at different predetermined voltages for reducing speed of motor and means for causing variations in the voltage impressed upon the first-mentioned means proportional to but wider in range than the variations in the speed of the motor.

1,062,111. ELECTRIC HEATER; J. L. Nylander, Seattle, Wash. App. filed Nov. 27, 1912. For administering injections; a heating tube provided with a resistance coil is slidably engaged on the flexible catheter pipe.

1,062,136. THERMOSTAT; T. H. Wurmb and R. Baumann, St. Louis, Mo. App. filed May 12, 1910. Pair of thermally operated springs and a fixed contact point, one of the springs having an elastic bifurcated end arranged to "snap" into engagement with the fixed point.

1,062,137. ELECTRIC FIRE ALARM; H. Barditzky, Memphis, Tenn. App. filed May 11, 1912. Adjustable highly expansive rod and an adjustable spring-pressed member co-acting therewith, the highly expansive rod having a graduated indicating dial.

1,062,139. ELECTRIC-LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed Dec. 9, 1908. Cap of the socket has a right-angled boss so that the socket will stand at a right angle to the pipe or conduit to which it is attached.

1,062,161. TELEPHONY; I Kitsee, Philadelphia, Pa. App. filed March 16, 1907. Duplexes the telephone circuit by generating the home impulse in two secondaries of inductoriums, causing the impulse in one secondary to be neutralized and causing the impulse of the far-off station to travel through one of the secondaries and receiving device.

1,062,168. ARC-LIGHT ELECTRODE; I. Ladoff, Cleveland, Ohio. App. filed Feb. 21, 1911. An inner core of copper having an uncovered arcing surface and elsewhere a covering of iron.

1,062,185. ELECTRIC SWITCH; L. J. Pierce, Pittsburgh, Pa. App. filed Sept. 24, 1912. Contact members carry balls which make firm contact with the switch blade pivoted on said members.

1,062,199. STEP AND THREAD PLATE; W. P. Stephenson, London, Ontario, Canada. App. filed June 13, 1912. For electric cars; resistance coils in tread plate prevent accumulation of ice and snow.

1,062,228. INCANDESCENT LAMP LOCK AND SEAL; H. Davies and J. Cooke, West New York, N. J. App. filed July 9, 1912. Sheet-metal band surrounding the socket with its ends riveted together, said band having a groove to receive a bead on the socket and an inwardly extending flange to engage the plug of the lamp.

1,062,240. REFILLABLE FUSE PLUG; F. H. Kaiser, Buffalo, N. Y. App. filed Oct. 3, 1911. Fuse wire has angularly bent ends clamped between internal washers and the end caps of the shell.

1,062,249. APPARATUS FOR AUTOMATICALLY OPERATING PIANO PEDALS; C. W. Nyström, Karlstad, Sweden. App. filed April 17, 1910. Spring-pressed rod engaging the pedal is normally held inactive by pneumatic means governed by a valve which is controlled by the music strip.

1,062,281. FORMING MACHINE FOR TUNGSTEN FILAMENTS; J. W. Howell, Newark, N. J. App. filed May 7, 1908. Plurality of receptacles for filaments with connections whereby a stream of fluid may be passed through the receptacles.

1,062,282. AUTOMATIC CLOCK-WINDING MEANS; M. Karsch, Los Angeles, Cal. App. filed July 31, 1912. Electric winding motor with cam-operated arms controlling a clutch and circuit through the motor.

1,062,292. AUDIBLE SIGNAL FOR DETERMINING THE TEMPERATURES OF SEA WATER; A. McNab, Bridgeport, Conn. App. filed April 25, 1912. Receptacle open to sea water, thermometer therein, signal circuit including the thermometer and manual means for testing to determine the present temperature.

1,062,299. ELECTRIC STOVE; C. A. Pfanstiehl, North Chicago, Ill. App. filed Nov. 11, 1912. Inner and outer independently heated concentric parts separated by an air space.

1,062,305. INCANDESCENT LAMP; C. P. Steinmetz, Schenectady, N. Y. App. filed Sept. 8, 1908. Wire strip or globule of magnesium, calcium or lithium deposed near leading-in wires is vaporized by discharge between the wires, thus absorbing the gases accumulated in the globe and automatically restoring the high vacuum.

1,062,344. COOKING AND DOMESTIC UTENSIL HEATED BY ELECTRICITY; J. Mann, Prague, Austria-Hungary. App. filed Dec. 17, 1912. Pottery vessel made in different parts with heating medium engaged in grooves in such parts.

1,062,361. GENERATOR OF INTERMITTENT ELECTRIC CURRENTS; M. P. Ryder, White Plains, N. Y. App. filed Jan. 3, 1906. Permanent magnets producing flux in opposite directions through a coil and a reciprocating armature which is detached from the core of the coil to break simultaneously a magnetic circuit of one source through the coil and a magnetic shunt for the other source around the coil.

1,062,362. ELECTRIC FURNACE FOR THE CONTINUOUS MANUFACTURE OF GLASS; M. Sauvageon, Colombes, France. App. filed Aug. 5, 1909. A mass of molten glass in a combined melting and refining chamber constitutes a heating resistance and serves to support by flotation a mass of glass-producing material, electrodes being immersed in the molten glass.

1,062,380. REGULATOR FOR DYNAMO-ELECTRIC MACHINES; V. G. Apple, Dayton, Ohio. App. filed Oct. 2, 1911. Worm gearing from dynamo rotates contact at greatly reduced speed and by such rotation prevents "freezing" of the vibratable contact therewith.

1,062,381. SIGNALING SYSTEM; C. E. Beach, Binghamton, N. Y. App. filed Sept. 23, 1910. Circuit, including receiving and recording devices, is normally permanently closed through high-resistance paths at the central station so that electromagnetic actuating parts of the receiving and recording devices will normally receive insufficient current flow and will not operatively affect their recording or signaling mechanism.

1,062,387. MEASURED-SERVICE TELEPHONE SYSTEM; J. Erickson, Chicago, Ill. App. filed Nov. 22, 1911. Check-controlled system in which it is necessary to deposit two or more coins before conversation can be carried on.

1,062,388. METHOD OF CHANGING THE COMPOSITION OF IRON AND STEEL; B. Ford, Philadelphia, Pa. App. filed Jan. 12, 1909. The body of iron or steel is interposed between contacts and is heated uniformly by increasing electrical resistance at or near the contacts to provide heat to compensate for the heat conducted away by both contacts.

1,062,408. FLAMING-ARC HEADLIGHT; L. M. McBride, Denver, Col. App. filed June 12, 1911. Pair of magnet poles, terminating one above and one below the ends of the electrodes, with the poles, the center of the arc and the focal point of the reflector all in the vertical plane containing the focal axis of the reflector.

1,062,431. METHOD FOR PURIFYING CARBON FOR CARBON FILAMENTS; J. Billiter, Vienna, Austria-Hungary. App. filed Sept. 25, 1911. Obtains carbon containing less than one-tenth of 1 per cent impurities by transferring carbon into colloidal carbon by disintegration and thereafter separating the colloidal carbon.

1,062,522. SEPARATION OF SUBSTANCES BY THE WET MAGNETIC PROCESS; G. Ullrich, Magdeburg, Germany. App. filed Dec. 23, 1909. Forms a vertically and downwardly flowing liquid wall in a magnetic field, delivers material to the wall in a direction transverse to the flow of liquid, magnetically raises the magnetizable particles in the liquid wall and then conveys them cut of the liquid wall to a point of deposit.

1,062,551. ELECTROMECHANICAL SYSTEM FOR THE PROPULSION OF AUTOMOBILES; H. Pieper, Liège, Belgium. App. filed Sept. 25, 1906. Thermal motor and dynamo mechanically connected as a unit; separate units for the separate drive wheels, with storage battery; dynamos serving both as generators and motors.

1,062,555. ELECTRIC FIXTURE; E. L. Simons, Lansdowne, Pa. App. filed Oct. 1, 1912. Socket fixture for autos, etc., which by substitution of parts may be adapted either to a cigar lighter or a trouble lamp.

1,062,559. CUSHION FOR DIAPHRAGMS OF TELEPHONIC AND LIKE INSTRUMENTS; W. P. Stunz, Lansdowne, Md. App. filed Sept. 23, 1912. A spring-metal loop-formed annulus having undulatory branches bearing against the diaphragm and against the back of the transmitter casing.

1,062,571. PROCESS OF ELECTRIC WELDING; C. R. Murray, L. R. Brink and W. K. Malmstrom, Chicago, Ill. App. filed April 15, 1912. An upstanding strip is welded to the face of a plate by engaging the strip at substantially the edge to be welded, engaging a small area of the plate opposite the spot to be welded and passing current between places of engagement.

1,062,577. TELEPHONE SYSTEM; E. E. Kleinschmidt, Brooklyn, N. Y. App. filed Sept. 8, 1910. Local batteries eliminated; central-station selector generator, selectors at substations and a common telephone battery.

13,564 (reissue). APPARATUS FOR THE PRODUCTION OF HIGH-POTENTIAL ELECTRIC CURRENTS; D. G. McCaa, Lancaster, Pa. App. filed March 17, 1913. (Original patent No. 1,047,545, dated Dec. 17, 1912.) Pulsating unidirectional current is supplied to primary of transformer by a pole changer interposed between primary of the transformer and a condenser which is in series with the primary and the source of current.